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Fixed and Variable Elements in the Calculation of Machine Depreciation[1]

By Orlin J. Scoville

Knowledge of the influence of depreciation on the costs of machinery usage is required for such decisions as custom-hire vs. ownership of machines and timely replacement. Here, the author is developing a technique for estimating the joint effects of the fixed and variable elements on depreciation.

FOR most classes of capital goods, depreciation comprises both fixed and variable elements. The variable part of depreciation arises from wear and depends upon extent of use. But equipment also loses value when not in use. This fixed component may arise as a result of rust or decay, or from obsolescence. Variable depreciation might be called "wear-depreciation," and fixed might be called "time-depreciation."

The relative importance of these two causes of depreciation depends upon the amount the equipment is used. With limited use, obsolescence or deterioration will be of increased significance in determining the number of years of life: with extensive use, the machine will probably wear out before it loses its value for other reasons.

In an abstract sense, wear-depreciation and time-depreciation are additive. When a machine is written off as valueless, the decision is based both upon the cost of keeping the machine in repair and upon the inconvenience or inefficiency of using that machine compared with a newer model. Similarly, in placing a value on a machine at any age, one would probably consider the wear it had received and the extent to which it had been made obsolete by newer models.

In practice, it is simpler to view time-depreciation and wear-depreciation not as components to be added together, but as separate measures of the life of a machine. One expresses the maximum years over which investment in a machine should be spread from the standpoint of probable obsolescence or of probable damage from the weather and other deterioration. The other indicates the maximum acres or number of hours of service that could be expected before a machine would be so badly worn that it would be desirable to replace it rather than keep it in repair.

If the annual amount of use of a machine is known, both of these rates of depreciation can be expressed either as annual rates or as rates per acre or per hour. Then, to arrive at a depreciation charge to fit a given amount of annual use,

[1] This paper covers part of a study of relationships between size of farm and production costs in northeastern Nebraska. The data apply specifically to farms in the western part of the Corn Belt at the 1935–39 average price level but the conclusions as to method are of general applicability.

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it is necessary only to choose the higher of the two rates.[2]

The Objective

The purpose of the discussion in this report is to develop a method for estimating depreciation that reflects the joint effects of the fixed and variable elements influencing the costs of machinery use. The distinction between fixed and variable costs is a separate problem from the distribution of depreciation charges over the life of a machine. It refers only to variations in amount of annual depreciation when yearly use of a machine is varied. This annual charge is most easily discussed in terms of "straight-line depreciation," although for some purposes it would be preferable to compute it as a constant percentage of remaining value, or by the sinking fund or compound-interest method. In this paper, depreciation will be treated as an equal amount during each year of machine life—in other words, straight-line depreciation. The need for making a distinction between fixed and variable aspects of depreciation has been generally ignored in farm-management studies.

Basic Information From Previous Studies

In a Montana wheat study,[3] depreciation is considered to be more closely related to amount of use than to years of use, and is therefore calculated as a constant cost per hour or per acre. This makes no allowance for variations in obsolescence, and assumes long years of life for machines on small farms.

A Nebraska study of machinery costs outlines a method whereby depreciation is calculated on the basis of the annual average decline in sale value of each machine, as reported by farmers.[4] Because of the rapid rate of decline in resale values of machines in the first years of use, this method gives a high rate of depreciation for machines that have been on the market only a few years, and a low rate for machines the average age of which is high. For example, the "cost when new" of tractor-drawn 16-inch 2-way plows is given as $155; and of tractor-drawn 2-bottom 14-inch gang plows as $106.[5] Annual depreciation of the 2-way plow is shown as $24.35, or $0.34 per acre, and of the gang plow as $8.83 or $0.10 per acre.[6] These annual depreciation charges would be sufficient to replace the 2-way plow after 6.4 years or 456 acres; and the gang plow after 12 years, or 1,060 acres. There seems to be no reason why there should be much difference in length of life of these two types of plow and it is probable that most of the difference could be explained by differences in their average ages. Two-way plows have come into general use within relatively recent years.

A study of tractor costs in Nebraska shows depreciation costs for tractors classified by amount of annual use.[7] This would seem to give a variable rate of depreciation which would allow for differences between the effects of obsolescence and of wear. However, an examination of data in the bulletin leads to the conclusion that the farmers who supplied the figures did not distinguish between the two. Tractors that averaged only 115 hours of use per year were reported as having an average life of 14 years, while those used 744 hours per year were expected to last 13 years. On this basis, tractors in the first group would have an average operating life of 1,610 hours, and in the second of 8,928 hours, which indicates that farmers look at tractor depreciation largely in terms of obsolescence rather than wear.

According to an Iowa study of the cost of power, "The expression of life of tractors in terms of years involves an error in procedure. It is more realistic to express the tractor's life in hours of use, since this determines more nearly the time required to wear it out, even though obsolescence also affects its life to some extent." [8] This statement does not

[2] A discussion of fixed and variable depreciation charges as applied to farm machinery appears on pp. 527–528 of FARM MANAGEMENT by J. D. BLACK, MARION CLAWSON, C. R. SAYRE, and W. W. WILCOX, issued in 1947. These authors treat fixed and variable depreciation as additive (table 64, p. 527) but give no method for arriving at the values to be used.

[3] STARCH, E. A. FARM ORGANIZATION AS AFFECTED BY MECHANIZATION. Mont. Agr. Expt. Sta. Bul. 278. 1933. p. 46.

[4] MILLER, FRANK and RUDEN, W. L. COST OF OPERATING MACHINERY ON NEBRASKA FARMS. Nebr. Agr. Expt. Sta. Bul. 366, 1944, p. 10.

[5] Ibid. Table 1.

[6] Ibid. Table 9.

[7] MILLER, FRANK, RUDEN, W. L., and SMITH, C. W. COST OF TRACTOR POWER ON NEBRASKA FARMS. Nebr. Agr. Expt. Sta. Bul. 324, Rev. 1942, pp. 5 and 6.

[8] GOODSELL, W. D. COST AND UTILIZATION OF POWER AND LABOR ON IOWA FARMS. Iowa Agr. Expt. Sta. Res. Bul. 258. 1939. pp. 332–3.

seem to square with figures given in the bulletin, however, for 2-plow standard tractors were estimated by farmers to have an average life of 13.8 years or 4,237 hours, while 3-plow standard tractors were said to last 14.0 years or 6,104 hours. Again, farmers' estimates were more consistent with respect to estimated years of life than with hours of use.

A Kansas study of the cost of using machinery takes farmers' estimates of years of life as the basis for calculating depreciation. The authors observe that these estimates include elements of wear and obsolescence. Although amount of annual use is not shown, data for tractors, combines and mowers are grouped according to number of cultivated acres per farm, and it is observed that "As farm size in cultivated acres increases, the estimated service life of tractors tends to decrease . . . The estimated life of combines and mowers, however, does not appear to be affected by the size of the farm." [9] For tractors, estimated average life ranges from 14.6 years on farms with from 50 to 99 acres of cultivated land to 9.4 years on farms with 600 to 649 acres cultivated.

Another table in that bulletin shows that the number of days a tractor was used per year increased with size of farm although there was only a slight tendency toward greater annual use of combines, and no significant difference in the number of days that mowers were used. It appears that, in the Kansas study, farmers' estimates of the years of life of tractors did take into account both wear and obsolescence.

According to an Arizona study, "The cash or trade-in value of used machinery that is not worn out or obsolete is usually less than its use value to the farmer. To depreciate machinery according to its cash or trade-in value is, consequently, not a sound method. Farm machinery and equipment loses value both from the wearing out of parts due to use and from obsolescence . . . . The fact that obsolescence does take place makes it necessary to set a maximum life for a machine, or in other words, a minimum rate of depreciation, even though the machine may be used very little. Those machines which are used so much that they wear out before they become obsolete must be depreciated according to the number of hours they are used rather than at the minimum depreciation rate." [10] The author then proceeds to set up a dual schedule of rates based upon survey data. Inspection of the "maximum years of life" as given in this schedule leads one to suspect that, while the author intended the figures to refer only to obsolescence, they actually are influenced to a considerable extent by wear. Few farmers would consider many types of implement obsolete in the 5- to 15-year span there given. A float, for example, is given a maximum life of 5 years.

Although each of these studies recognizes that depreciation is a matter partly of wear and partly of obsolescence and deterioration, only the Arizona study makes an effort to measure the separate effects of each.

For many purposes it is satisfactory to treat machine depreciation entirely as a fixed cost and to decide upon some average length of life that will reflect the total of the joint effects of wear, deterioration, and obsolescence. The simplicity of this calculation may outweigh the advantages that a more precise computation might have. But for some purposes this simple approach is not satisfactory, particularly if it is desired to study the costs of operating a given machine over a wide range of amounts of annual use. Treatment of depreciation as a fixed cost leads to erroneous conclusions when it is used in the calculation of custom rates necessary to cover machine costs, or in comparing custom rates with costs of ownership of a machine, or in comparing costs of using different sizes of machines. For these purposes the accuracy of estimates of depreciation can be substantially improved by separating variable costs from fixed depreciation costs.

Procedure

In developing the present procedure for estimating depreciation which reflects the joint effect of fixed and variable elements, the method used resembles that suggested but not developed by Thompson. The principal differences are in manner of presentation, and in the use of rather arbitrarily assumed maximum years of life rather than a figure based on survey data. This assumption is made because of the lack of reliable estimates of rates of time-depreciation that are independent of amount of use.

[9] Fenton, E. C., and Barger, E. L. THE COST OF USING FARM MACHINERY. Kans. Engr. Expt. Sta. Bul. 45, 1945. pp. 16–21.

[10] Thompson, N. O. EFFICIENCY IN THE USE OF FARM MACHINERY IN ARIZONA. Ariz. Agr. Expt. Sta. Bul. 174, 1941. p. 277.

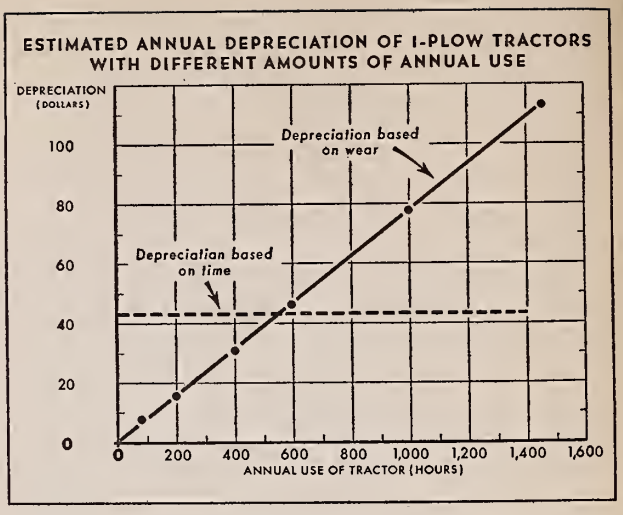
The approach to maximum years of life for a machine is in terms of the number of years in which it would seem prudent for a farmer to write off his investment in a given machine, regardless of use.[11] This will depend primarily upon the likelihood that the machine will become obsolete. The prudent maximum-investment life for a harrow would be considerably longer than for some newly introduced machine such as a sugar-beet harvester.

For tractors, the prudent maximum life is here assumed to be 16 years, based upon a study of length of service of farm tractors.[12] This study reports the estimated number of tractors on farms January 1, 1941, by year of manufacture. About 85 tractors out of 100 bought in 1930 were still in use 10 years later. From the 12th to 16th year of use, the rate of disappearance of tractors was high; only about 20 percent of the tractors bought in 1924 were still in use on January 1, 1941. Disappearance tended to slow up after 16 years and a few tractors remained on farms after 30 years. According to these data, the average length of service of tractors has been about 12 years.

Sixteen years is taken as the basis for figuring minimum annual depreciation because it would seem from the above data that at this age the rapid disappearance of tractors due to wear and obsolescence is about over, and many of the tractors still remaining are probably used very little.

Prudent maximum-investment life for corn-pickers and combines is arbitrarily taken at 15 years. Information concerning present ages of pickers and combines in an Iowa study [13] and a frequency distribution of the estimated years of life of combines in Kansas [14] indicate that it is probable that relatively few of these machines could be expected to last longer than 15 years.

In addition to an estimate of minimum annual depreciation, information is needed as to the approximate amount of service, or use, that can be expected of a machine, without regard to obsolescence. For tractors, a service life of 8,928 hours is assumed. This is the average life of tractors operated for 600 hours or more per year, as reported in the Nebraska survey.[15] Life of tractors used the most is taken because the estimated life of this group should most nearly represent depreciation from wear. But, even in this group, tractors were expected to last an average of 12 years, so it is probable that obsolescence entered into the estimate to some extent.



The service life of corn pickers and combines is taken from the Iowa study [16] by multiplying average acreage covered per year by estimated years of life. To a greater extent than for tractors, this estimate is influenced by obsolescence. Estimated total acres of service for the 1-row corn picker is 907 (68.2 acres x 13.3 years); and for the 2-row picker, 1,759 acres (162.9 acres x 10.8 years). Service life for combines is computed at the average of the three sizes given, or 1,590 acres for a 5-foot machine (146.2 acres x 10.9 years). Variations in the reported figures between individual sizes make it inadvisable to use separate figures for each size of machine. Combines are assumed to have the same number of hours of life, and life in acres proportional to width of cut.

Results

Depreciation per year and per hour of use, for tractors of different sizes and with different amounts of use, are shown in table 1. This table also shows the amount of other fixed costs, includ-

[11] As most implements retain some salvage or trade-in value, it is assumed that original cost should be written down to 10 percent of new value.

[12] Brodell, A. P., and Pike, R. A. farm tractors; type, size, age and life. Bur. Agr. Econ., F. M. 30, Washington, D. C. 1942. [Processed.] p. 12.

[13] Heady, E. C., Hopkins, J. A., and McKibben, E. G. cost, distribution, and utilization of farm machinery in iowa. Iowa Agr. Expt. Sta. Res. Bul. 323. 1943. p. 91.

[14] Fenton and Barger, op. cit., p. 18.

[15] Miller, Ruden, and Smith, op. cit., p. 5.

[16] Heady, Hopkins, and McKibben, op. cit.

ing taxes, insurance and interest on the average investment. These are estimated to total 7 percent of average investment, which is considered to be half the new cost.[17] It will be noted that under the conditions assumed, annual depreciation from use exceeds annual time-depreciation at a little more than 550 hours of service per year. In figure 1, fixed annual depreciation is shown as a broken line and variable depreciation as a solid line. The depreciation information in table 1 does not represent the sum of these two, but whichever one is higher for each given amount of annual use.

The principal difference between results obtained with this method of calculating depreciation and with the usual straight-line depreciation with an "average" number of years life is that the method used here gives lower rates of depreciation with a limited use, and a higher rate with large use. Table 1 shows that total fixed costs of tractor operation decline very rapidly with increasing annual use up to about 250 or 300 hours; thereafter they decline rather slowly.

When operating costs are included, total tractor costs per hour (exclusive of labor of the operator) are as shown in table 2. Operating costs are assumed to be $0.20 per hour for 1-plow (10dbhp) tractors; $0.23 per hour for 2-plow (18dbhp) tractors; and $0.32 per hour for 3-plow (26dbhp) tractors. These figures are adapted from data in Nebraska Experiment Station Bulletin 324.

Calculated in the same way as for tractors, annual and per acre depreciation and fixed costs for corn pickers are shown in table 3. Under the conditions assumed, annual depreciation due to wear becomes greater than time-depreciation at about 65 acres for the 1-row picker, and at about 115 acres for the 2-row machine. At about 120 acres, total depreciation and fixed costs per acre become less for the 2-row than for the 1-row picker. This is primarily due to the fact that the 2-row

[17] This is the estimate of these costs that is given in Nebr. Bul. 366, op. cit., p. 10.

TABLE 1.—*Depreciation and fixed-cost schedule for tractors for specified hours operated* [1]

Hours operated per year	1-plow tractor				2-plow tractor				3-plow tractor			
	Depreciation per year [2]	Fixed cost per hour			Depreciation per year [4]	Fixed cost per hour			Depreciation per year [5]	Fixed cost per hour		
		Depreciation	Other [3]	Total		Depreciation	Other [3]	Total		Depreciation	Other [3]	Total
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
50	43. 75	0. 875	0. 490	1. 36	68. 75	1. 375	0. 770	2. 14	81. 25	1. 625	0. 910	2. 54
75	43. 75	. 583	. 327	. 91	68. 75	. 917	. 513	1. 43	81. 25	1. 083	. 607	1. 69
100	43. 75	. 438	. 245	. 68	68. 75	. 688	. 385	1. 07	81. 25	. 812	. 455	1. 27
125	43. 75	. 350	. 196	. 55	68. 75	. 550	. 308	. 86	81. 25	. 650	. 364	1. 01
150	43. 75	. 292	. 163	. 46	68. 75	. 458	. 257	. 72	81. 25	. 542	. 303	. 84
175	43. 75	. 250	. 140	. 39	68. 75	. 393	. 220	. 61	81. 25	. 464	. 260	. 72
200	43. 75	. 219	. 122	. 34	68. 75	. 344	. 192	. 54	81. 25	. 406	. 228	. 63
250	43. 75	. 175	. 098	. 27	68. 75	. 275	. 154	. 43	81. 25	. 325	. 182	. 51
300	43. 75	. 146	. 082	. 23	68. 75	. 229	. 128	. 36	81. 25	. 271	. 152	. 42
350	43. 75	. 125	. 070	. 20	68. 75	. 196	. 110	. 31	81. 25	. 232	. 130	. 36
400	43. 75	. 109	. 061	. 17	68. 75	. 172	. 096	. 27	81. 25	. 203	. 114	. 32
450	43. 75	. 097	. 054	. 15	68. 75	. 153	. 086	. 24	81. 25	. 181	. 101	. 28
500	43. 75	. 088	. 049	. 14	68. 75	. 138	. 077	. 22	81–25	. 162	. 091	. 25
550	43. 75	. 080	. 045	. 12	68. 75	. 125	. 070	. 20	81. 25	. 148	. 083	. 23
600	46. 80	. 078	. 041	. 12	73. 80	. 123	. 064	. 19	87. 60	. 146	. 076	. 22
700	54. 60	. 078	. 035	. 11	86. 10	. 123	. 055	. 18	102. 20	. 146	. 065	. 21
800	62. 40	. 078	. 031	. 11	98. 40	. 123	. 048	. 17	116. 80	. 146	. 057	. 20
900	70. 20	. 078	. 027	. 10	110. 70	. 123	. 043	. 17	131. 40	. 146	. 051	. 20
1,000	78. 00	. 078	. 024	. 10	123. 00	. 123	. 038	. 16	146. 00	. 146	. 046	. 19
1,100	85. 80	. 078	. 022	. 10	135. 30	. 123	. 035	. 16	160. 60	. 146	. 041	. 19
1,200	93. 60	. 078	. 020	. 10	147. 60	. 123	. 032	. 16	175. 20	. 146	. 038	18
1,300	101. 40	. 078	. 019	. 10	159. 90	. 123	. 030	. 15	189. 80	. 146	. 035	. 18
1,400	109. 20	. 078	. 018	. 10	172. 20	. 123	. 028	. 15	204. 40	. 146	. 032	. 18

[1] A new 1-plow tractor costs $700, 2-plow tractor, $1,100, and a 3-plow tractor $1,300. The assumed maximum length of service of a tractor is 16 years or 8,928 hours.

[2] Depreciation is $43.75 per year or $0.078 per hour operated, whichever is greater.

[3] Based on 7 percent per year of half the cost of a new tractor.

[4] Depreciation is $68.75 per year or $0.123 per hour operated, whichever is greater.

[5] Depreciation is $81.25 per year or $0.146 per hour operated, whichever is greater.

TABLE 2.—*Total operating cost per hour for tractors according to hours of annual use* [1]

Operated per year (hours)	Operating costs per hour								
	1-plow tractor			2-plow tractor			3-plow tractor		
	Depreciation and fixed-costs [2]	Operating costs [3]	Total	Depreciation and fixed-costs [4]	Operating costs [3]	Total	Depreciation and fixed-costs [5]	Operating costs [3]	Total
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
50	1. 36	0. 20	1. 56	2. 14	0. 23	2. 37	2. 54	0. 32	2. 86
75	. 91	. 20	1. 11	1. 43	. 23	1. 66	1. 69	. 32	2. 01
100	. 68	. 20	. 88	1. 07	. 23	1. 30	1. 27	. 32	1. 59
125	. 55	. 20	. 75	. 86	. 23	1. 09	1. 01	. 32	1. 33
150	. 46	. 20	. 66	. 72	. 23	. 95	. 84	. 32	1. 16
175	. 39	. 20	. 59	. 61	. 23	. 84	. 72	. 32	1. 04
200	. 34	. 20	. 54	. 54	. 23	. 77	. 63	. 32	. 95
250	. 27	. 20	. 47	. 43	. 23	. 66	. 51	. 32	. 83
300	. 23	. 20	. 43	. 36	. 23	. 59	. 42	. 32	. 74
350	. 20	. 20	. 40	. 31	. 23	. 54	. 36	. 32	. 68
400	. 17	. 20	. 37	. 27	. 23	. 50	. 32	. 32	. 64
450	. 15	. 20	. 35	. 24	. 23	. 47	. 28	. 32	. 60
500	. 14	. 20	. 34	. 22	. 23	. 45	. 25	. 32	. 57
550	. 12	. 20	. 32	. 20	. 23	. 43	. 23	. 32	. 55
600	. 12	. 20	. 32	. 19	. 23	. 42	. 22	. 32	. 54
700	. 11	. 20	. 31	. 18	. 23	. 41	. 21	. 32	. 53
800	. 11	. 20	. 31	. 17	. 23	. 40	. 20	. 32	. 52
900	. 10	. 20	. 30	. 17	. 23	. 40	. 20	. 32	. 52
1,000	. 10	. 20	. 30	. 16	. 23	. 39	. 19	. 32	. 51
1,100	. 10	. 20	. 30	. 16	. 23	. 39	. 19	. 32	. 51
1,200	. 10	. 20	. 30	. 16	. 23	. 39	. 18	. 32	. 50
1,300	. 10	. 20	. 30	. 15	. 23	. 38	. 18	. 32	. 50
1,400	. 10	. 20	. 30	. 15	. 23	. 38	. 18	. 32	. 50

[1] From table 1.

[2] Depreciation is $43.75 per year or $0.078 per hour operated, whichever is greater.

[3] Includes fuel, oil, grease, and repairs. Operator's labor not included.

[4] Depreciation is $68.75 per year or $0.123 per hour operated, whichever is greater.

[5] Depreciation is $81.25 per year or $0.146 per hour operated, whichever is greater.

picker has a useful life of approximately twice the acreage of the 1-row machine but does not cost twice as much.

Table 4 shows estimated total cost of using 1-row and 2-row pickers, including operator's labor at $0.14 per hour,[18] and a tractor cost taken from table 2 and assuming an average annual use of the tractor of 500 hours.[19] It is assumed that the 1-row picker is drawn with a 2-plow, and the 2-row with a 3-plow, tractor.

From table 4 it appears that under the assumed conditions, corn can be picked more cheaply with a 2-row picker at slightly more than 80 acres. If depreciation rates had been figured on the basis of the average years of life of corn pickers as reported in Nebraska Bulletin 366, it would have appeared that picking with a 1-row machine was cheaper for acreages of less than 140 acres.

A farmer with a given size of tractor capable of drawing either a 1- or a 2-row picker would have to adjust his power costs accordingly. Assuming he had a 3-plow tractor and that his power costs were $0.57 per hour, his power cost per acre drawing a 1-row picker would be $0.71 under the conditions assumed here, and about 65 acres of corn would justify purchase of a 2-row picker.

Table 4 can also be used as a guide to the acreage at which it would be cheaper for a farmer to hire his corn picked, rather than to own a picker. The approximate cost of custom picking in eastern Nebraska from 1935 to 1939 was $2.25 per acre, not including hauling from the field. Again referring to table 4, it seems that it would be cheaper, under the assumed 1935–39 conditions, to buy a 1-row picker if the acreage of corn to be picked is as much as 25 acres. If

[18] This was about the average hourly rate for labor hired by the month in Nebraska from 1935–39.

[19] This is approximately the average for tractors reported in Nebraska Bulletin 324, op. cit., p. 5.

TABLE 3.—*Depreciation schedule for corn pickers, adjusted for obsolescence* [1]

Acreage annual use	1-row picker				2-row picker			
	Depreciation per year [2]	Fixed cost per acre			Depreciation per year [4]	Fixed cost per acre		
		Depreciation	Other fixed costs [3]	Depreciation and fixed costs		Depreciation	Other fixed costs [3]	Depreciation and fixed costs
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20	29. 13	1. 46	0. 85	2. 31	46. 20	2. 31	1. 35	3. 66
30	29. 13	. 97	. 57	1. 54	46. 20	1. 54	. 90	2. 44
40	29. 13	. 73	. 42	1. 15	46. 20	1. 16	. 67	1. 83
50	29. 13	. 58	. 34	. 92	46. 20	. 92	. 54	1. 46
60	29. 13	. 49	. 28	. 77	46. 20	. 77	. 45	1. 22
70	33. 60	. 48	. 24	. 72	46. 20	. 66	. 38	1. 04
80	38. 40	. 48	. 21	. 69	46. 20	. 58	. 34	. 92
90	43. 20	. 48	. 19	. 67	46. 20	. 51	. 30	. 81
100	48. 00	. 48	. 17	. 65	46. 20	. 46	. 27	. 73
120	57. 60	. 48	. 14	. 62	46. 80	. 39	. 22	. 61
140	67. 20	. 48	. 12	. 60	54. 60	. 39	. 19	. 58
160	76. 80	. 48	. 11	. 59	62. 40	. 39	. 17	. 56
180	86. 40	. 48	. 09	. 57	70. 20	. 39	. 15	. 54
200	96. 00	. 48	. 08	. 56	78. 00	. 39	. 13	. 52
220	105. 60	. 48	. 08	. 56	85. 80	. 39	. 12	. 51
240					93. 60	. 39	. 11	. 50
260					101. 40	. 39	. 10	. 49
280					109. 20	. 39	. 10	. 49
300					117. 00	. 39	. 09	. 48
340					132. 60	. 39	. 08	. 47
380					148. 20	. 39	. 07	. 46
420					163. 80	. 39	. 06	. 45

[1] A new 1-row picker costs $485 and a 2-row picker $770. The assumed maximum length of service of a picker is 15 years.

[2] Depreciation is $29.13 per year or $0.48 per acre, whichever is greater.

[3] Based on 7 percent per year of half the cost of a new picker.

[4] Depreciation is $46.20 per year or $0.39 per acre, whichever is greater.

the operator values his own time at more than 14 cents an hour, it would not be economical for him to own a picker for so small an acreage. If he values his time at 50 cents an hour, he would need to have 45 acres.

Table 4 indicates that, with corn pickers, the rate of decline in costs per acre is low when the machine is used on as much as 90 or 100 acres of corn per year.

Comparable figures for depreciation and fixed costs of operating small combines are shown in table 5, and total costs in table 6. Tractor costs used in the latter table assume use of a 2-plow tractor for all three sizes of combine, use of a power take-off, and 1-man operation. Hauling costs are not included.

[20] Costs for the 6-foot combine may be somewhat out of line with costs for the other machines. Average new cost of this combine per foot of cut was reported as somewhat higher, and estimates of acres cut per hour per foot of width were somewhat lower, than for the other sizes.

Under conditions assumed, it would be more economical [20] to use a 4-foot combine up to about 60 acres of annual use, and to change from a 5-foot to a 6-foot combine at something over 200 acres. With a higher wage rate, it would be advantageous to use the larger combines with lower acreages.

It is estimated that the average custom rate for combining grain in northeastern Nebraska from 1935 to 1939 was about $2.50 per acre. From table 6, it would appear to be more economical for a farmer to have his own combine for as little as 25 or 30 acres of grain, assuming that he would be using his tractor for at least 500 hours per year.

For the combine, it appears that operating costs per acre decline rapidly with increasing annual use up to about 80 or 100 acres and decline slowly with additional use.

Many farmers, when deciding whether to buy a certain machine, already have a tractor of a suitable size for use with it, and need to base their calculations only on the marginal costs of added

TABLE 4.—*Total operating cost per acre for corn pickers according to annual acreage of use*

Acreage of annual use	Operating costs per acre							
	1-row picker				2-row picker			
	Depreciation and fixed [1]	Variable [2]	Total		Depreciation and fixed [1]	Variable [4]	Total	
			Excluding power	Including power [3]			Excluding power	Including power [5]
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20	2. 31	0. 28	2. 59	3. 15	3. 66	0. 21	3. 87	4. 28
30	1. 54	. 28	1. 82	2. 38	2. 44	. 21	2. 65	3. 06
40	1. 15	. 28	1. 43	1. 99	1. 83	. 21	2. 04	2. 45
50	. 92	. 28	1. 20	1. 76	1. 46	. 21	1. 67	2. 08
60	. 77	. 28	1. 05	1. 61	1. 22	. 21	1. 43	1. 84
70	. 72	. 28	1. 00	1. 56	1. 04	. 21	1. 25	1. 66
80	. 69	. 28	. 97	1. 53	. 92	. 21	1. 13	1. 54
90	. 67	. 28	. 95	1. 51	. 81	. 21	1. 02	1. 43
100	. 65	. 28	. 93	1. 49	. 73	. 21	. 94	1. 35
120	. 62	. 28	. 90	1. 46	. 61	. 21	. 82	1. 23
140	. 60	. 28	. 88	1. 44	. 58	. 21	. 79	1. 20
160	. 59	. 28	. 87	1. 43	. 56	. 21	. 77	1. 18
180	. 57	. 28	. 85	1. 41	. 54	. 21	. 75	1. 16
200	. 56	. 28	. 84	1. 40	. 52	. 21	. 73	1. 14
220	. 56	. 28	. 84	1. 40	. 51	. 21	. 72	1. 13
240					. 50	. 21	. 71	1. 12
260					. 49	. 21	. 70	1. 11
280					. 49	. 21	. 70	1. 11
300					. 48	. 21	. 69	1. 10
340					. 47	. 21	. 68	1. 09
380					. 46	. 21	. 67	1. 08
420					. 45	. 21	. 66	1. 07

[1] From table 3.
[2] Includes repairs and lubricants @ $0.11, and labor @ $0.17 per acre.
[3] Power @ $0.45 per hour or $0.56 per acre (2-plow tractor).
[4] Includes repairs and lubricants @ $0.11, and labor @ $0.10 per acre.
[5] Power @ $0.57 per hour or $0.41 per acre (3-plow tractor).

use of the tractor.[21] Such precision would hardly seem justified for most purposes.

In this discussion, it has been necessary to depend upon secondary data. These serve to illustrate the method but it would be desirable for greater accuracy to collect new data on the life of machines. Two estimates are needed for each machine: Maximum prudent investment life in years; and maximum acres, miles, or hours, of life that one would expect to get from a machine before it is worn out. Both of these estimates are rather subjective. One cannot accurately determine in advance the span of years over which a machine will become obsolete. Neither can one precisely determine the moment at which a machine becomes worn out. A machine that is frequently overhauled may not wear out for many years, whereas a machine that is kept in a poor state of repair may soon become in such bad condition that the cost of putting it in good running order is prohibitive. For their more expensive machines, however, farmers usually have a reasonably definite idea of what they consider normal service, as 100,000 miles for a car or 10,000 hours for a tractor. It is more difficult to obtain from them an expression of the likelihood that a machine will become obsolete in terms of a specific number of years, but even in this case they usually have a definite opinion that the value of some machines must be written off rather soon, whereas others are not likely to become obsolete for many years. It is possible to obtain serviceable estimates for both of these items by carefully interviewing a sample of farmers.

With these data, it would be possible to estimate with reasonable accuracy the minimum economical annual use, including custom, that a farmer should expect before it would pay him to acquire a given size of any type of machine. Information on this subject is now very limited.

[21] Once having bought the machine, they would include in their costs average total tractor costs.

TABLE 5.—*Depreciation schedule for combines according to acreage of annual use* [1]

Acreage of annual use	4-ft. combine				5-ft. combine				6-ft. combine			
	Depreciation per year [2]	Other fixed costs per year [3]	Depreciation and fixed costs		Depreciation per year [2]	Other fixed costs per year [3]	Depreciation and fixed costs		Depreciation per year [2]	Other fixed costs per year [3]	Depreciation and fixed costs	
			Per year [2]	Per acre			Per year [2]	Per acre			Per year [2]	Per acre
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20	29. 40	17. 15	46. 55	2. 33	36. 00	21. 00	57. 00	2. 85	46. 80	27. 30	74. 10	3. 70
30	29. 40	17. 15	46. 55	1. 55	36. 00	21. 00	57. 00	1. 90	46. 80	27. 30	74. 10	2. 47
40	29. 40	17. 15	46. 55	1. 16	36. 00	21. 00	57. 00	1. 42	46. 80	27. 30	74. 10	1. 85
50	29. 40	17. 15	46. 55	. 93	36. 00	21. 00	57. 00	1. 14	46. 80	27. 30	74. 10	1. 48
60	29. 40	17. 15	46. 55	. 78	36. 00	21. 00	57. 00	. 95	46. 80	27. 30	74. 10	1. 24
70	29. 40	17. 15	46. 55	. 66	36. 00	21. 00	57. 00	. 81	46. 80	27. 30	74. 10	1. 06
80	29. 40	17. 15	46. 55	. 58	36. 00	21. 00	57. 00	. 71	46. 80	27. 30	74. 10	. 93
90	31. 23	17. 15	48. 38	. 54	36. 00	21. 00	57. 00	. 63	46. 80	27. 30	74. 10	. 82
100	34. 70	17. 15	51. 85	. 52	36. 00	21. 00	57. 00	. 57	46. 80	27. 30	74. 10	. 74
120	41. 64	17. 15	58. 79	. 49	40. 80	21. 00	61. 80	. 51	46. 80	27. 30	74. 10	. 62
140	48. 58	17. 15	65. 73	. 47	47. 60	21. 00	68. 60	. 49	51. 52	27. 30	78. 82	. 56
160	55. 52	17. 15	72. 67	. 45	54. 40	21. 00	75. 40	. 47	58. 88	27. 30	86. 18	. 54
180	62. 46	17. 15	79. 61	. 44	61. 20	21. 00	82. 20	. 46	66. 24	27. 30	93. 54	. 52
200	69. 40	17. 15	86. 55	. 43	68. 00	21. 00	89. 00	. 44	73. 60	27. 30	100. 90	. 50
240	83. 28	17. 15	100. 43	. 42	81. 60	21. 00	102. 60	. 43	88. 32	27. 30	115. 62	. 48

[1] A new 4-ft. combine costs $490, 5-ft. combine $600, and a 6-ft. combine $780. The assumed maximum length of service of a combine is 15 years.

[2] Depreciation is $29.40 per year or $0.347 per acre, whichever is greater, for the 4-ft. combine; $36.00 per year or $0.340 per acre for the 5-ft. combine; and $46.80 per year or $0.368 per acre for the 6-ft. combine.

[3] Based on 7 percent per year of half the cost of a new combine.

TABLE 6.—*Total operating cost per acre for combining as related to acreage of annual use*

Acreage of annual use	Operating costs per acre											
	4-foot combine				5-foot combine				6-foot combine			
	Depreciation and fixed [1]	Variable [2]	Total		Depreciation and fixed [1]	Variable [2]	Total		Depreciation and fixed [1]	Variable [2]	Total	
			Excluding power	Including power [3]			Excluding power	Including power [3]			Excluding power	Including power [3]
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20	2. 33	0. 24	2. 57	3. 02	2. 85	0. 20	3. 05	3. 37	3. 70	0. 19	3. 89	4. 17
30	1. 55	. 24	1. 79	2. 24	1. 90	. 20	2. 10	2. 42	2. 47	. 19	2. 66	2. 94
40	1. 16	. 24	1. 40	1. 85	1. 42	. 20	1. 62	1. 94	1. 85	. 19	2. 04	2. 32
50	. 93	. 24	1. 17	1. 62	1. 14	. 20	1. 34	1. 66	1. 48	. 19	1. 67	1. 95
60	. 78	. 24	1. 02	1. 47	. 95	. 20	1. 15	1. 47	1. 24	. 19	1. 43	1. 71
70	. 66	. 24	. 90	1. 35	. 81	. 20	1. 01	1. 33	1. 06	. 19	1. 25	1. 53
80	. 58	. 24	. 82	1. 27	. 71	. 20	. 91	1. 23	. 93	. 19	1. 12	1. 40
90	. 54	. 24	. 78	1. 23	. 63	. 20	. 83	1. 15	. 82	. 19	1. 01	1. 29
100	. 52	. 24	. 76	1. 21	. 57	. 20	. 77	1. 09	. 74	. 19	. 93	1. 21
120	. 49	. 24	. 73	1. 18	. 51	. 20	. 71	1. 03	. 62	. 19	. 81	1. 09
140	. 47	. 24	. 71	1. 16	. 49	. 20	. 69	1. 01	. 56	. 19	. 75	1. 03
160	. 45	. 24	. 69	1. 14	. 47	. 20	. 67	. 99	. 54	. 19	. 73	1. 01
180	. 44	. 24	. 68	1. 13	. 46	. 20	. 66	. 98	. 52	. 19	. 71	. 99
200	. 43	. 24	. 67	1. 12	. 44	. 20	. 64	. 96	. 50	. 19	. 69	. 97
240	. 42	. 24	. 66	1. 11	. 43	. 20	. 63	. 95	. 48	. 19	. 67	. 95

[1] From table 5.

[2] Repairs @ $0.10 per acre plus labor @ $0.14 per hour ($0.14; $0.10; and $0.09 per acre).

[3] Assumes use of 2-plow tractor with all combines and 500 hours annual use of tractor. Power cost equals $0.45 per hour ($0.45; $0.32; and $0.28 per acre).

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Father-Son Farm Agreements in Virginia

By W. L. Gibson, Jr., and F. D. Hansing

Throughout the country father-son agreements are being developed to aid farm boys in their attempt to climb the "agricultural ladder." In this discussion the authors report on the extent to which these agreements are being used and the conditions under which they are possible for a county in Virginia.

STUDIES in land tenure, especially those from 1941 to the early 1930's, emphasized the opportunity for a young man to attain farm ownership through a series of steps under which he served an apprenticeship while acquiring the necessary capital. This series of steps, called the agricultural ladder, progressed from farm laborer to tenant to mortgaged-owner to full ownership. The young farm boy, working as a farm laborer, accumulated enough capital and experience to become a tenant, and so secured a tangible share in a farm business. At the same time he served the interest of an older farmer who was no longer able to farm efficiently and wished to give up the work either partially or entirely. Frequently there was some degree of kinship between the two parties. Often a son was the tenant and his father or mother was the landlord.

In more recent years considerable interest has developed in father-son farm agreements which approximate a partnership to help the agricultural ladder to function. This type of tenure arrangement has its origin in three increasing trends: A greater capital requirement in farming,[1] a longer period of life expectancy, and better opportunities for employment off the farm.

According to the 1945 Census of Agriculture, the average capital investment in land and buildings in Virginia on farms of 30 acres or more was $6,554. For farms of 100 to 179 acres, the average investment was $5,827. If size was increased to 180 to 259 acres, the average investment increased to $9,179. To operate an average farm in Virginia, an additional $1,000 to $2,000 is needed for equipment and work stock, $1,500 to $2,000 is needed in livestock, and $500 to $1,000 in other forms of working capital. Apparently $2,000 to $4,000 must be accumulated by a farm laborer now before he can successfully become a tenant and, assuming a safe margin as down payment on a farm, he needs $7,000 to $10,000 before advancing to ownership, unless he inherits a farm or its equivalent.

Gradual prolongation of life expectancy as a result of advancements in medical and other sciences is giving us a larger proportion of our farmers approaching retirement age. Then the war prevented many older farmers from letting go. In 1910, 11 percent of the farm operators in Virginia were 65 years of age and older. This proportion had increased to 19 percent by 1945.

Recent trends in decentralization of industrial activity and increased professional services have offered farm youth more opportunities for employment off the farms. Farm youth who are not interested in farming as an occupation have found it easy to get started in other vocations.

Two problems are evident. First, there is the young man who is striving to accumulate capital to begin farming on his own. Second, there are the established farmers who wish to assist their children and at the same time safeguard their resources and income during their declining years. It would seem that the two problems could be solved on many farms through forming a father-son agreement. The increased interest in such agreements in the last few years indicates they have a definite place in the tenure arrangement on farms in this country.

In July 1948, the Virginia Agricultural Experiment Station and the Bureau of Agricultural Economics began a study of father-son farm agreements in Augusta County of Virginia. The study had two major purposes: (1) to learn the extent to which father-son agreements are being used to aid in the effective functioning of the agricultural ladder and (2) to evaluate conditions under which father-son agreements are adaptable to a typical farming community. Data were obtained from a random sample of 143 farms of 50 acres or more and from a selected sample of 55 farms on which

[1] North Central Regional Land Tenure Committee. capital needed to farm in the midwest. (North Central Regional Publication No. 5.) Minn. Agr. Expt. Sta. Bul. 389. 1946. p. 8.

a son was known to be working with his father. This article is a progress report on the study.

Locality Studied

Augusta County lies near the head of the famous Shenandoah Valley of Virginia. Approximately half of its land area comprises the rolling calcareous soil belt of the main valley which is flanked on the east and west by the Blue Ridge and Allegheny Mountains respectively. The valley is an area of rich agricultural resources. Its fertile soils, equable climate, level topography, and its economic location form the basis of the county's well-balanced and relatively prosperous agricultural economy. Practically all the mountains are covered with forest, but in the valley or foothills the forests are confined mainly to crests of low ridges, steep slopes, and along some streams. Most of the mountains are included in the George Washington National Forest.

The agriculture of the county is diversified. Dairying, poultry, livestock, and fruit furnish the major part of cash farm income. The principal crops are corn, wheat, barley, and hay. Apples and peaches flourish in some localities.

The 1945 Census of Agriculture showed the approximate land area of Augusta County to be 639 thousand acres, of which 59 percent was in farms. The total number of farms of all sizes was 3,803; approximately half of these had less than 50 acres each. Tenancy in the county was considerably less than in some other parts of the State. Full owners accounted for the largest tenure group, comprising 80 percent of all farm operators and occupying 81 percent of all the land in farms. Tenants accounted for only 11 percent of the farmers, the other 9 percent being part-owners and farm managers.

Industrially, Augusta County is important, too. There is a balance between agricultural and manufacturing enterprises. Staunton and Waynesboro are centers of manufacturing industries, and several smaller towns have manufacturing plants. The 1940 Census of Manufactures reported 69 manufacturing establishments employing 5,183 wage earners at an annual wage of over 4.8 million dollars in the county. The value of products manufactured in 1939 exceeded 27 million dollars. With the development of industrial plants in the county, part-time farming has increased and probably accounts at least partly for the large proportion of farms that have less than 50 acres. In 1945, a total of 1,594, or 42 percent of all the farm operators, reported that they worked off their farms a part of their time in 1944; they averaged 219 days work at outside employment.

Farms Without Father-Son Agreements

Conditions on each and every farm in any area are not favorable to the formation of father-son agreements. In Augusta County, data were obtained from 62 farms where there were no agreements. These farms provide some data on family and farm conditions that are not conducive to agreements. For convenience of analysis the farms may be divided into two groups; one of 37 farms with either no sons or sons too young and another of 25 farms from which the sons have gone to other employment.

No sons or sons too young.—Bachelors were operating five farms and on seven others the farmers were married but there were no children in the families. On these farms the only possibility of an agreement lies with a young relative or with some boy of no kinship. Although no case of an agreement with one not a relative was found in this study, the writers found several farmers each of whom has expressed a wish to take a young man into the business when an interested and capable one can be found.

On the remaining 25 farms of the 37-farm group, the farmers' families had children too young to be considered in regard to agreements. Some of these children may enter agreements with their parents later when they have finished school. Several of the farmers expressed an interest in making an agreement with a son when the boy becomes of age. These 25 farmers averaged 45 years of age; eight were less than 40 years old.

Sons in other employment.—In this group of 25 farms, the families had 60 sons in all, 56 of whom were 21 years old or older and had left their homes for other work. This group represents farms whose sons could be available, but conditions were not suitable for the formation of agreements. These farmers averaged 60 years of age, with nine who were 65 years old or older. The approximate average age of the fathers at the time the youngest sons left the farms was 53 years. Only two had made attempts to keep a son on the home farm; neither succeeded because the sons were more interested in other kinds of work. Two

other farmers are now working out agreements under which a son will return from outside employment to the home farm in 1949. These farmers are 65 and 67 years old. Their ages at the time the sons left the farms were 51 and 50 years, respectively.

On seven of the farms there were nine sons in all, who, according to the fathers, had a definite interest in farming. Three are now farming on their own farms; all of these had aid from their parents in getting established. A fourth is a part-time farmer. The other five are not farming at present but two are the ones who expect to begin farming under father-son agreements in 1949. Another of these five lost his father recently; he wants to buy the home place but thus far has not reached an agreement with the other heirs. The remaining two were sons of a tenant farmer; when they left the farm, their father was renting a small farm that was unsuitable for the employment of two additional workers.

Analysis of the data from the 25 farms shows some reasons for not making such agreements and conditions that are not conducive. Most important, perhaps, is that many farm youth are not interested in farming and should not be encouraged to enter father-son agreements, as that would delay their training in work they prefer. Success in farming depends considerably on a liking for one's work just as is true in other occupations. Agreements entered under such circumstances are likely to be unsuccessful; neither son, father, nor farm resources are likely to benefit very much from it. That such agreements would likely fail was indicated many times by farmers both with and without sons operating with them. Several farmers—some with sons working with them and some not—told the enumerators they thought parents should not encourage their children to enter work for which they have no liking; to do so would be a great injustice to the sons, and they doubted any benefit either to father or to farm in an arrangement under such circumstances. Furthermore, on several farms where a son recently began working with his father, the son was on a wage basis until it was certain that he wanted to farm. In other words, the agreement was such that it could be easily discontinued, if it was found that the son would prefer other employment.

Factories located in the county had attracted a larger proportion of the 60 sons who had left the farms than any other single element; 25 of these young men are now working in the factories. Service institutions and professional work accounted for another 22 of the young men.

It cannot be assumed that all of the sons who left for other employment had a dislike for farm work. When the fathers were asked their opinions as to why the sons chose other work, they usually answered that the boy disliked farm work; or he wanted to be a doctor, lawyer, or some professional or skilled worker; or there were better opportunities elsewhere. As this phrase, "better opportunities elsewhere," indicates that conditions on the home farms influenced some sons in their decisions, the records on these farms were examined for characteristics which might have influenced the decisions. Size and degree of productivity were considered first because they were notable exceptions to the usual answers given by the fathers. That is, several fathers said their farms were too small to provide enough income for both the father and son, and several mentioned that their farms were of such low productivity that industrial employment offered a better opportunity. The data verified the premise that size and productivity of the home farm influenced some sons who left home (table 1). Sixteen of the farms, or 73 percent, have crop yields of less than the average for the county, and slightly more than a third had less than 100 acres of total land. Compared with the farms that had father-son agreements, these farms distinctly did not offer much opportunity to the youth who grew up on them. The sons preferred nonfarm employment but they might have chosen to remain in agricultural work if they had had a chance to start on larger farms of at least average productivity.

Most of the sons reared on the farms in the two groups of low productivity were working in the industries of the county or as skilled and unskilled laborers in various trades at the local centers. More than one-half of the sons who grew up on the large farms that had above-average productivity were professional men.

Several minor factors influenced some sons to go into nonfarm employment, such as (1) the son's health or some physical handicap, (2) the father's disposition, (3) the dislike of the son's wife for farming or for living on a farm, and (4) an agreement between the father and one son that left no opportunity for the other sons.

TABLE 1.—*Size and productivity of 22 farms* [1]

Size and productivity of farms	Farms	Average per farm		Crop index	Animal units per farm	Average	
		Acreage	Crops produced			Age of father	Sons per family
Without father-son agreement:							
Less than 100 acres—	*Number*	*Acres*	*Acres*		*Number*	*Years*	*Number*
Low productivity	3	77	22	96	6. 94	70	3. 7
High productivity	5	69	44	135	12. 31	62	1. 6
100 acres or more—							
Low productivity	8	146	40	96	11. 15	62	2. 5
High productivity	6	180	64	119	15. 04	58	2. 7
With father-son agreement	[2] 22	248	87	130	31. 06	61	2. 4

[1] Three of the farmers who were tenants when the sons left for nonfarm employment are omitted because they are not now on the same farms they occupied when their sons left.

[2] Farms in the random sample only. Had the farms in the selected sample been included, the difference would have been larger.

Possibility of father-son farm agreements.—Apparently the extent of father-son agreements in a particular area depends upon the age of the farmers, the interest of the sons in farming, the conditions of agriculture in the area, and several minor factors. An estimate from the random sample indicates that one out of every 10 farms (50 acres or more in size) in Augusta County has a son operating under some type of agreement with his parents. This proportion must of course be interpreted in terms of the broad definition of a father-son agreement set up for the study. A more rigid definition, confining agreements to those in which the son actually participates under a profit-sharing arrangement in the major enterprise or the total farm business, would mean the inclusion of decidedly fewer agreements in this county.

Many farmers are not familiar with arrangements like or similar to the father-son agreements. This often means that a son leaves the home farm when he would have remained if a real opportunity had been provided. As more and more farmers and their sons see agreements working successfully on neighboring farms, and as experience accumulates in the formation and carrying out of such agreements, their importance in our farm land tenure will probably increase. The extent of the increase will depend principally upon future conditions of capital requirements and farm income.

Undoubtedly more widespread adoption of these family arrangements would be beneficial both to the families and the land resources. It would mean a degree of stability of farm tenure, especially if the son continued to operate the farm after the death of the father. On the other hand, a degree of fluidity has always been a desirable feature of farm tenure in this country. Such fluidity allows for an individual's movement from one farm to another, or from the farm to nonfarm employment, in accordance with his wishes and capabilities. Father-son agreements should not and probably will not be adopted to an extent that would be detrimental to the mobility necessary in the individual farmer's efforts to adjust himself to land resources and to advance in proportion to his ability.

Farms With Father-Son Agreements

Father-son agreements were in operation on 77 of the farms on which records were obtained—22 in the random sample and 55 in the selected sample. These farms averaged 278 acres, on which an average of 98 acres of crops and 40 animal units of livestock were produced. The average yield of the crops on these farms was 33 percent higher than the average for the county. The fathers averaged 61 years of age; 30 were more than 64 years old. In all, 86 sons and 4 sons-in-law were operating with their parents or parents-in-law on the 77 farms, under some type of agreement. An additional 82 sons had left these farms for other employment.

Some significant variations from these averages were found. Four farms had less than 100 acres each. Agreements on three of these farms were apparently due to special considerations: on two the fathers' health no longer allowed them to

operate their farms, and on the third the agreement was entered to allow the son to obtain "On-the-Job-Training" under the Veterans' Program. Four small farms overcame the handicap of limited acreage by renting additional land. Three farms owning between 100 and 150 acres each, rented additional land which appeared to be necessary to the agreement.

Two farms had yields that were below the average for the county. The low yields on one farm came from the freezing out of the small grain. On the other farm they were due to the low productivity of the land. The owner of this farm was 81 years old; he had managed the farm without assistance until 1946, but the productivity had declined greatly during his late years, according to the son-in-law who now operates with him. The farm was reported to have been in a high state of productivity at one time.

Fathers on nine of the farms were under 50 years of age. Four had full-time jobs off the farm, two were unable to do heavy work, and on one farm the son was working with his father under the "On-the-Job-Training" program.

Formation of the agreements.—What brought the fathers and sons together under these agreements? That was a question to be answered. Analysis of key information obtained, plus the judgment of the fathers and the enumerators who took the records, provided a basis for classification of the factors. Although they are presented singly, the factors were usually interrelated. Often several merged to create a condition that was favorable to the formation of the agreement.

The interest of a son in farming and the parents' wish to encourage and help him to get started was the most important factor. This combination was given as a paramount cause of 21 of the agreements (table 2). But it cannot be separated from all of the other factors and it should be understood that the interest of the son in farming goes hand in hand with all of them.

This group of 21 farms includes a diversity of agreements. Some are just beginning; others have been running for considerable time. A few of the sons have just reached 21 years of age; others are in their thirties. A few receive wages only; others are substantial partners in the business. As a whole, the young men have accumulated enough capital to own some equity in the business. That is the important point and the degree of capital accumulation is closely related to the years the agreement has been in operation. Five of the older among them owned an interest in the land besides a share of the livestock and equipment.

Closely related is a second group of nine farms where the sons are working with their parents more or less on a trial basis, planning to enter a formal agreement later. They are working primarily for wages. They are relatively young, and have accumulated little capital. One father said, "I am trying my boy out and if, after a year or so, he shows interest and ability to take hold, I expect to take him into the business with me. Meanwhile, he can accumulate some savings toward buying a share of the livestock and equip-

TABLE 2.—*Important factors in formation of father-son agreements*

Factor	Farms	Sons	Average age		Type of payment received by sons			
			Sons	Fathers	Paid wages	Share from—		
						Certain enterprises	Total farm business	Net profits
	Number	*Number*	*Years*	*Years*	*Number* [1]	*Number* [1]	*Number* [1]	*Number* [1]
Interest of son in farming	21	29	30	59	3	8	7	3
Testing period of son	9	9	21	51	6	2	1	0
Age of father	13	14	35	74	0	2	9	2
Health or death of father	15	18	32	63	1	3	9	2
On-the-job-training	7	8	24	52	0	5	1	1
Father's nonfarm employment	5	5	23	49	1	1	3	0
Miscellaneous	7	7	25	61	4	3	0	0

[1] Number of farms using methods shown.

ment." Some of the other young men have apparently passed through this stage.

The age of the father and the health or death of the father were considered the key factors on 13 and 15 of these farms respectively. These factors are more closely related to the circumstances of the parents but that does not mean that the sons had less opportunity. All conscientious parents want to encourage their sons. If to this wish is added the need of the parents for the aid of the son, the son's opportunity becomes greater, not less. The sons in these agreements were in their late twenties or thirties. Only four were under 26 years and three of these were young sons who had taken over because of the recent illness or poor health of the fathers. In most of these agreements, the sons owned a substantial share of the livestock and equipment, although frequently they were paying off notes they gave when they bought their interest. Many, especially the older ones, own their shares free of debt; and on 12 of the 28 farms the sons had acquired an interest in the real property. In all cases the accumulation of capital had been enough to establish the son in farming, and in some cases it apparently had proceeded to such an extent that the son would take over the home farm completely either at the retirement or at the death of his parents.

After World War II many boys returned to their home farms. Under the Veterans' Program these sons could get "On-the-Job Training" by entering an agreement with their fathers. This was considered to be the key factor in the formation of eight agreements on seven farms. The sons were comparatively young and had accumulated very little capital, so they possessed relatively small equities in the businesses. The primary emphasis in these agreements was apprenticeship. Some of these sons plan to enter permanent agreements with their parents at the termination of the temporary GI agreements. For these sons the "On-the-Job Training" serves as a period of testing, training, and accumulating some capital toward purchase of an interest in the livestock and equipment.

Method of sharing income.—In many respects, the method of sharing the income is the focal point in father-son agreements. The varying circumstances of the families when agreements are started, the diversity of the sons' responsibilities and equities at the formation of agreements, and the progress made by sons in assuming responsibility and accumulating assets in the business, are expressed through the method of sharing the income. It is obvious, therefore, that there will be a variety of arrangements in any given area. This diversity may be readily grouped under (1) wage agreements, (2) sharing income from a designated enterprise or enterprises, (3) joint operators sharing the total farm income according to an agreed division, and (4) partnerships, usually of a limited nature. A fifth arrangement was identified as cash or share renting by the son from the father as landlord but as only one of the agreements studied was of this type, it is omitted from the analysis in this section.

On 15 of the farms studied, 18 sons were operating with their parents under wage agreements. This type of arrangement is often the beginning stage of a business relationship between the father and son. While it is running the son learns whether or not he wants to make farming his life work, and the father can teach the boy many fundamentals of managing different enterprises on the farm. Therefore, wage agreements are often temporary; they may be terminated on short notice without undue hardship to either party. These sons were comparatively young; 12 of the 18 were under 25 years. Most of them had accumulated little if any capital and had little if any equity in the farm business. During this trial period, the son may accumulate savings toward a later purchase of an interest in one or more of the enterprises.

But it would be erroneous to assume that all wage agreements are temporary and made for a trial period. Several of those studied appeared to be entirely on an employee-employer basis without apparent consideration of a change of status after a few years. On the other hand, the plan on several farms was for the son to stay on a wage basis until the father retires or dies; on one of these farms, the father paid the son a bonus each year in addition to the agreed wages, but the amount of the bonus was not fixed in the agreement and apparently varied from year to year according to variation in the farm income.

On 24 farms 27 sons operated with their fathers under an agreement which gave them either all of the income from one or more enterprises or an agreed share of the income from one or more

TABLE 3.—*Method of sharing income under father-son agreement*

Method	Farms	Sons	Average age		Time son worked under agreement	Percentage of sons owning a share of property	
			Sons	Fathers		Personal	Real
	Number	*Number*	*Years*	*Years*	*Years*	*Percent*	*Percent*
Wage agreements	15	18	24	56	3	6	0
Income from enterprises	24	27	27	58	5	93	0
Joint operators	29	33	31	62	9	94	33
Partnerships	8	11	35	66	13	91	73
Cash rent	1	1	----	----	----	----	----

enterprises. Like the wage agreement, this type is frequently used during a trial period during which the father tests the son and the son accumulates experience and capital. This arrangement is often used as a beginning agreement if the son has accumulated some livestock under an FFA or 4–H Club project while still in school. Twenty-five of these 27 sons had obtained an equity in one or more of the enterprises on the farms. The average age of the sons was 27 years.

They averaged older than those who were operating under wage agreements and they apparently assumed a larger share of the responsibility and management, especially in those enterprises in which they held part of the capital investment. On some farms with relatively large enterprises—like dairying, broilers, or turkeys—the sons will continue on an enterprise-sharing agreement for a long time, sometimes throughout the life of the agreement.

On 29 farms 33 sons had agreements with their parents as joint operators. Under these agreements the father and son work together in the production of the total farm business, each paying an agreed proportion of the expenses and each receiving an agreed proportion of the income. Usually the division of the expenses and income is the same as the proportion of the capital in livestock and machinery owned by the son. That is, if the son owns one-half the livestock and machinery, he will pay one-half the expenses and receive one-half the income. Thus the shares vary from farm to farm according to what the son has accumulated. On these 29 farms, 19 sons received one-half the income, 4 received one-fourth, 4 received one-third, and 1 received three-fourths of the income. On one farm the son received all the income; he was operating the farm of his deceased father for his mother, and she accepted her support instead of a share of the income. There was considerable evidence that the proportions in the sharing had changed as the years passed under this type of agreement. At the beginning of joint operatorship, the son may have capital for only one-fourth; but he gradually accumulates additional capital, is allowed to invest it in the business, and so increases his share in the income from the farm. In addition to accumulating a larger share of the personal property, 11 sons had acquired an interest in the real property. In these instances, the agreements had usually reached an advanced stage.

The sons who were working under joint-operator agreements averaged 31 years of age, 7 and 4 years older respectively than the wage and enterprise groups. The sons who had accumulated an interest in the real property averaged 37 years of age compared with 28 years for those who had only an interest in the personal property.

Sons attain joint operatorship with their fathers through various methods. Several of these had progressed from wage agreements to enterprise agreements to joint operators; others began on wage agreements and had moved directly to joint operators; a few had been joint operators from the beginning. These last included sons who had been given an interest in the personal property by their parents, sons who worked several years at nonfarm employment and returned to the home farm, and veterans who returned from service. On several farms, the son had operated with his father for several years beyond the age of 21 without receiv-

ing income, except for his support and spending money. Then, at some strategic time like the marriage of the son, it was assumed that he owned a certain share of the personal property and the two began to work on a joint-operator basis.

On 8 farms 11 sons were operating with their parents on a partnership basis. On these farms the total income was credited to a farm account from which all expenses were paid. At a stated time each year, the farm profits were calculated and were divided between father and son according to an agreed plan. In a legal sense it is doubtful that any of these agreements could be termed a true partnership. From the standpoint of agreements, it offers another alternative to fathers and sons when choosing a method of sharing the income. The division of the profits varied. Three sons received one-sixth each; four received one-fourth; one received one-third; two received one-half, and one received two-thirds. These sons have progressed in accumulating capital, 10 having acquired a large interest in the personal property and 8 having acquired an interest in all or a part of the real property. The average age of the sons in this group was 35 years—4 years older than the average among the joint-operators. Partnerships are an advanced stage of father-son agreements. The sons are usually old enough to have accumulated enough experience to assume the greater part of the management of the farm, and the fathers have reached or are approaching the age of retirement. The most distinctive feature is the shift in management principally to the son, or from the older to the younger generation.

Advancement of sons under agreement.—This grouping of the agreements into four types does not imply that the types are distinct. Nor should it be assumed that one type of agreement is better on certain farms and another type is better for other farms. Actually, the types appear to be different stages in a father-son agreement, and are closely tied to each other through the son's advance in experience and capital accumulation. Records from Augusta County were too few to warrant statistical analysis of the progress made by sons in passing from one stage to another. Then, too, the records were heavily weighted by sons who had been operating only a few years with their parents and thus had not passed to the more advanced stages. In spite of these limitations in the data, the analysis of 69 records giving the information wanted and the emphasis which fathers put on the "working of a son" rather than on "taking a son into an agreement," seem to warrant the conclusion that father-son farm agreements are a process under which the son gradually gains experience and capital.

On the 69 farms on which data are available, 41 sons were working under either a wage or an enterprise agreement (table 4, p. 86). A few of these agreements are likely to continue in their present form; there is no indication of plans to modify them later so that the son will participate in the total farm business. But the majority of them represent an apprenticeship stage through which the son is to go before he shares in the total farm business as either a joint operator or a partner. Of the remaining 38 sons on the 69 farms, 16 had at one time worked for wages but had advanced to other methods of income-sharing by the time the record was taken. Three of these had reached only the enterprise-sharing stage; another 10 were joint operators; all except one having gone directly to joint operatorship from the wage agreement. The remaining three were now under partnership agreements. Only two sons had gone through as many as three stages—one began under a wage agreement, then received a share of income from certain enterprises, and now is a joint operator. The other began on a wage agreement, shifted to a joint operator, and now has partnership agreement.

Of the 21 sons who started as joint operators or partners, without first working through an apprenticeship, 16 began under special conditions. Seven were veterans who were taken in jointly by their fathers when they returned from World War II, four had worked at other employment and then returned to the home farms, and two worked on the home farm several years beyond the age of 21 without any income except support and spending money, and then went directly into a joint-operator arrangement.

Conclusions

Father-son farm agreements occupy an important and strategic place in American land tenure. They are a means whereby a young man can gradually accumulate experience and capital for a career in farming. At the same time they provide a way for an older farmer to continue the

TABLE 4.—*Steps of advancement under father-son agreements*

Stage of present agreement	Steps in advancement through method of sharing income with son	Sons working under agreement
		Number
Apprenticeship	Paid wages	18
	Shares income from certain enterprises	23
	Paid wages—shares income from certain enterprises	3
Joint operator	Shares income from total farm business	18
	Paid wages—shares income from total farm business	9
	Paid wages—shares income from certain enterprises—shares income from total farm business.	1
Partnership	Shares in net profits	3
	Paid wages—shares in net profits	2
	Paid wages—shares income from total farm business—shares in net profits	1

efficient operation of his farm during his declining years. Under agreements both the family capital and the family labor are effectively used in the interest of both the younger and the older generations. Furthermore, the productivity of the farm is maintained or it may even increase through improved practices.

No single type of agreement is superior, considering all conditions and all farms in a given area or locality. Each family first decides what its circumstances are and are likely to be and then drafts an agreement to meet its specific requirements. It seems best to have the arrangement looked upon as a process; that is, it need not be a permanent or rigid arrangement although it should look toward stability. At the beginning, the son can serve an apprenticeship by working for wages or, if he has accumulated some livestock in an FFA or 4–H Club project, he can start by sharing the income in that particular enterprise. After several years as an apprentice, or when he has gained some experience and accumulated some capital, the agreement can be so changed that the son can buy an interest in the total farm personal property and then receive an agreed share of the total farm income. This share may be increased as the son gains further capital and experience. Finally, when the father is ready to withdraw from active management, the son can take over the management of the farm and operate it on either a joint owner or a partnership basis. He may also start accumulating an interest in the real property.

But, of course, it is not necessary for all sons to pass through all the stages. If conditions of the family permit and the parents feel sure of the son's interest in farming, he may begin as a joint operator. In Augusta County this was done on some farms by giving the son an interest in the personal property; on other farms, by selling the son an interest, the parents taking his note for payment.

All farms in all parts of the country do not lend themselves to the formation of father-son agreements. It might not be desirable to have it so. But, in view of the recent trends in increased capital requirements in farming and a greater life expectancy of our farmers, it is probable that such agreements will become increasingly important in land tenure. To the degree that they are successful they will add stability to our tenure process.

Use of Semi-Controlled Mail Surveys for Initiating New Statistical Series

By Robert S. Overton [1]

Initiating a new statistical series necessitates constant vigil to insure representativeness, especially when the data are collected by mail. This paper reports on the use of current data from a State Farm Census in the absence of historical information for eliminating selectivity bias that may develop in mail surveys.

The Problem

TRADITIONALLY the size of the pig crop has been estimated semi-annually by the Bureau of Agricultural Economics. These estimates are widely known as the Spring and Fall Pig Crop Reports. The spring pig crop includes sows farrowed from December 1 to June 1; the fall pig crop covers the months June 1 to December 1. Agricultural interests have long wanted more frequent estimates of sows farrowed. Requests have been most numerous and urgent when conditions are abnormal—when there have been abrupt changes in hog-corn price ratios, short supplies of feed grains, and unusual weather.

Two principal barriers to more frequent information were (1) Operating funds and administrative personnel were too limited to allow an enumerative approach that would permit establishment of the new series of data and (2) the only sample data available were the rural mail carriers' livestock surveys of June and December which were of limited value in making a current monthly or quarterly estimate, because the data were either intentions to farrow or a report of performance for the preceding 6-month period. But the rural carriers' survey results did point up the fact that, even where the farms are relatively homogeneous, a large degree of both sampling and nonsampling error would be inherent in the mail returns.

As background estimates related to more frequent specific survey dates were not available, the solution apparently was either to build up patiently the required historic regression or to devise a method of measuring currently the total error in a mail survey that could be adapted to the problem.

The Solution

A limited statistical project was made possible through an allotment of R. M. A. funds to the Iowa Department of Agriculture. The time element practically dictated that a method be found of measuring the total error in the returns from the mail surveys. Briefly, the technique as evolved may be described as subsampling a master sample with a known parameter which in turn had been taken from a universe with a known parameter.

Iowa has an Annual State Farm Census that is believed to be as complete for major farm items as it is possible to attain. All farmers are interviewed annually, shortly after the first of the year, by local assessors to obtain data on the preceding year's crops and livestock and the number of sows farrowed or to be farrowed during the current spring season. The tabulation of the numbers of spring sows farrowed and acres of corn harvested, based on the State Farm Census, gave figures approximately equal to the official estimates of the Crop Reporting Board of the Bureau of Agricultural Economics (table 1).

Procedure

A question on number of sows farrowed was added to the regular monthly Crop Reporter questionnaire. The question was originally phrased as indicated in form 1 (p. 88). This wording proved to be inadequate because, at first, a number of respondents reported intentions and then kept

[1] The author is indebted to A. V. Nordquist, Head of the Division of Livestock and Poultry Statistics, Bureau of Agricultural Economics, and A. J. King, formerly of the Statistical Laboratory, Ames, Iowa, who contributed to the development of the principles and statistical methodology used in the study, and to Glenn D. Simpson of the Division of Livestock and Poultry Statistics, who assisted in the development of the working details and office procedure for putting the plan into effect.

TABLE 1.—*Estimates by Bureau of Agricultural Economics of Iowa corn acreage and spring sows farrowed, compared with data from Annual Iowa State Farm Census, by years, 1941–47*

Year	Harvested corn acreage			Spring sows farrowed (Dec–June)		
	B. A. E. estimate	State farm census	Census as percentage of estimate	B. A. E. estimate	State farm census	Census as percentage of estimate
	Thousands	*Thousands*	*Percent*	*Thousands*	*Thousands*	*Percent*
1941	9, 069	9, 043	99. 7	1, 704	1, 604	94. 1
1942	9, 568	9, 526	99. 6	2, 028	1, 965	96. 9
1943	10, 716	10, 619	99. 1	2, 454	2, 454	100. 0
1944	11, 037	10, 937	99. 1	1, 939	1, 906	98. 3
1945	10, 706	10, 631	99. 3	1, 842	1, 798	97. 6
1946	11, 134	11, 047	99. 2	1, 768	1, 730	97. 9
1947	10, 410	10, 330	99. 2	1, 962	1, 905	97. 1

reporting the same numbers of sows and pigs as farrowings, in later months. For example, one farmer reported 40 head of sows and no pigs each month for December, January, and February, then in March reported 40 sows and 275 pigs. He reported 40 sows and 260 pigs in both April and May. It was found that he had failed to read the subheadings of the inquiry and was reporting his total numbers of spring sows each month. It is later pointed out that this type of error can be detected and eliminated by proper editing, but, in an effort to minimize such answers, the question headings were changed to show the month of farrowing in the larger type, as shown in form 2.

(1)		(2)	
Sows Farrowed		SOWS FARROWED IN JUNE	
Number of Sows which farrowed on this farm during December 1947	Number of Pigs saved from all litters farrowed on this farm during December 1947	Number of Sows which farrowed on this farm during June 1948	Number of Pigs saved from all litters farrowed on this farm during June 1948
Number	Number	Number	Number

Using these monthly returns, a series was started on average number of sows farrowed per month in Iowa. Admittedly these averages were highly selective and some adjustments were needed to make them representative of the universe sampled. A measure of the extent of the error that would have resulted from using the raw data may be obtained from table 2.

When the State Farm Census was selected as the source of control data, the procedure called for locating the names of monthly crop reporters on the State Farm Census books and taking off certain basic information highly correlated with spring-sow numbers. Where possible, each respondent from the general crop reporter group was identified on the census lists and the following control items were taken from the 1946 State Farm Census rolls: (1) Total land in farm for 1946, (2) total 1946 corn acres, and (3) sows to farrow in the spring of 1947. These items were then summarized. Upon completion of the matching, it was found that 78 percent of the Crop Reporter farms, or 1,380 out of a total of 1,773, had been located on the assessors' lists.

In passing it may be mentioned that, as clerical help was limited, only one hasty search was made for any given name. Rechecks showed that the total matching with the census rolls could be raised to between 85 and 90 percent through a more thorough search. Among the reasons some names cannot be located were illegible writing in either name or the control data on census rolls and changes in names, as between our records and the census, in regard to partnerships or hired-tenant operations. Then too a crop reporter may live in town and be a farm owner not an operator; the Census would list the farm operator only. Or a crop reporter may have moved to another township or county from that reported for him on census rolls.

The question arises as to the possible effect of the missing farms. It was implicitly assumed that

TABLE 2.—*Estimated data on sows farrowed in Iowa, monthly, December 1947–May 1948*

Month	Sows farrowed						
	Average for crop reporters survey		Expansion to State estimate [1]		B. A. E. estimate	Survey as percentage of B. A. E. estimate	
	Per farm	Per 100 acres of land	206,000 farms	34,703,000 acres		Per farm	Per land in farm
	Number	*Number*	*Thousands*	*Thousands*	*Thousands*	*Percent*	*Percent*
1947: December	0. 080	0. 039	16	14	7	229	200
1948:							
January	. 111	. 055	23	19	10	230	190
February	. 535	. 266	110	92	60	183	153
March	2. 712	1. 340	559	465	401	139	116
April	4. 930	2. 399	1, 016	833	768	132	108
May	3. 128	1. 562	644	542	461	140	118
Total	11. 496	5. 661	2, 368	1, 965	1, 707	139	115

[1] The number of farms and acres of land used for expansion were from the 1947 Annual State Farm Census.

TABLE 3.—*Control data for 1946*

Item	Farms	Total land in farms	1946 corn acreage	1947 spring sows	Average per farm		
					Size of farm	Corn acreage	Spring sows
	Number	*1,000 acres*	*1,000 acres*	*1,000 head*	*Acres*	*Acres*	*Head*
State Farm Census	206, 155	34, 703	11, 047	1, 905	168. 3	53. 6	9. 24
Crop reporters	1, 380	285	91	18	206. 2	65. 7	13. 09
					Percent	*Percent*	*Percent*
Correction factor [1]					81. 6	81. 6	70. 6

[1] Census universe as percentage of crop reporters sample.

they were no different from those for which control data were available. This assumption may or may not be valid, but under the method adopted for removing error, the question becomes academic, as it has no bearing on the estimates.

The returns from the matched farms were summarized and table 3 was constructed to bring out the comparison with the totals from the State Farm Census.

Although the average crop-reporter farm was larger than the average for the universe, he also had more sows farrowed per farm acre and more per corn acre. Therefore, a greater correction was necessary in regard to sows than in regard to either corn acres or land in farm. Data in table 3 made apparent that the control item which would produce the most satisfactory correction factor was the spring farrowings of sows. The 70.6 percent shown in table 3 represents the adjustment to be applied to the current reports on monthly sow farrowings per farm.

The only further assumption necessary to make the direct expansion is that each monthly subsample is a true estimate of the crop reporters' universe. There was some doubt about this and there was the question as to the composition of the 22 percent of the sample that was not matched against the Iowa census list. To avoid difficulties

TABLE 4.—*Estimates of 1948 Iowa spring sows, monthly, December 1947–May 1948*

Item and month	Control data		Mailed survey data from crop reporters					
	Farms	1947 spring sows per farm	Sows farrowed	Sows per farm	Adjustment factor [1]	Corrected sows per farm	Estimated sows on 206,000 farms	Percentage of total sows farrowed
	Number	*Head*	*Head*	*Head*	*Percent*	*Head*	*1,000 head*	*Percent*
State farm census	206, 155	9. 24						
Crop reporters	1, 380	13. 09						
1947: December	753	13. 17	60	0. 080	70	0. 056	12	0. 7
1948:								
January	760	13. 14	84	. 111	70	. 078	16	. 9
February	783	13. 23	419	. 535	70	. 374	77	4. 5
March	889	12. 81	2, 411	2. 712	72	1. 953	402	23. 5
April	718	13. 06	3, 540	4. 930	71	3. 500	721	42. 2
May	647	12. 24	2, 024	3. 128	75	2. 346	483	28. 2
Total							1, 711	100. 0

[1] Sows farrowing in the spring per farm, as reported by the census, as a percentage of spring sows per farm as reported by crop reporters.

that might arise from these two causes, it was decided to tabulate each current monthly report on sow farrowings comparable with the census control data; thus each month's report would have a correction factor of its own. Table 4 gives the control data, the monthly averages as reported, the corresponding monthly correction factors, and the estimated farrowings.

When computing the monthly factors shown in table 4 it was necessary to add up the spring sows, reported in the 1946 census, for those particular respondents who returned a schedule for the given month. The average per farm from the survey group was compared with the average per farm for the universe (Farm Census), These two figures were then used to compute the percentage correction that would reduce the current month's survey average of sows farrowed to a universe base. This adjustment is shown in table 4. The sows per farm have now been adjusted to represent the average for the universe. The final step expands the per farm figure of sows farrowed to a State estimate, which is a product of the adjusted sows per farm multiplied by the census number of farms. This gives the final estimate shown in table 4.

Results

Since the computations from the monthly survey were made and reported before the release of the June 1948 Rural Carriers' Livestock Survey and before the tabulation of the 1948 farrowings made from the State Farm Census became available, it is possible to have an objective test of the monthly estimates. Table 5 summarizes the comparison of these estimates and the State census figures.

TABLE 5.—*Spring sows in Iowa, 1947 and 1948*

Item	1947	1948	Percentage change 1947 to 1948
	Thousands	*Thousands*	*Percent*
B. A. E. official estimates	1, 962	1, 707	87. 0
State Farm Census	1, 905	1, 645	86. 4
Total of monthly estimates		1, 711	

A further source of error concerns the seasonal pattern of farrowings. It was necessary to assume that the seasonal trend of the highly selective sample was the same as the trend for the universe. This assumption is admittedly tenuous, but an analysis of check data indicates that the errors introduced are not extensive, and are compensating, so they tend to cancel out in the total for the period. Table 6 compares the monthly estimates and the seasonal pattern as reported by the June Rural Carriers' Survey covering 5,000 hog farms.

The following comparison may not be completely valid as it is not certain that all of the response errors associated with original wording

TABLE 6.—*Sows farrowing in spring in Iowa, monthly, December 1947–May 1948*

Month	Percentage of total		
	Seasonal pattern	Monthly estimates	Difference
1947:	*Percent*	*Percent*	*Percent*
December	0. 2	0. 7	−0. 5
1948:			
January	. 3	. 9	−. 6
February	3. 0	4. 5	−1. 5
March	23. 5	23. 5	
April	46. 8	42. 2	+4. 6
May	26. 2	28. 2	−2. 0
Total	100. 0	100. 0	0

of the monthly question regarding sows were eliminated. A seasonal correction could be worked out and applied but at present it is doubtful that check information is accurate enough so that a thoroughly satisfactory seasonal modification of the reported data could be made.

Administrative Aspects

Careful analysis indicates that this technique has wide application in the field of mailed surveys provided some basic control data are available. Costs are not high since much of the work can be done by relatively inexpensive clerical help. Results are immediately available because direct expansions are made and there is no necessity for building up a long historical background of survey data in order to set up regressions that will remove the total error. It should be emphasized that the monthly surveys regarding sows have provided an accurate estimate under somewhat difficult circumstances. For example the extent of the change in farrowings in the spring season of 1948 was considerably larger than normal. The text of the inquiry was unlike that to which the respondents were accustomed, and there was no standardized editing procedure for use as a guide in handling the unusual cases.

When dealing with a small sample, it is extremely important that the reported data be carefully edited to eliminate intentions, repetition, and errors due to misunderstanding of the questions. In the present case, the control information provided an accurate base for removing most of the duplication, and the question on number of pigs saved was useful when the repetition of intentions reports were being eliminated.

TABLE 7.—*Control data from 1947 State Farm Census*

Item	Average per farm		Correction factor [1]
	Crop reporters sample	Census universe	
	Acres	*Acres*	*Percent*
Size of farm	209. 7	169. 8	81. 0
Corn harvested	62. 19	50. 58	81. 3
	Number	*Number*	*Percent*
People living on farm	4. 22	3. 73	88. 4
Calves raised	9. 51	7. 21	75. 8
Sows to farrow	11. 15	8. 06	72. 3
Fall pigs raised	20. 95	12. 85	61. 3
Cows kept for milk	6. 12	5. 45	89. 1
Hen and pullet layers	159. 9	131. 8	82. 4
Feeder cattle purchased	8. 41	4. 63	55. 1

[1] State farm census universe as percentage of crop reporters' sample.

In this method of removing error in mailed surveys, the statistician must be certain that the correction factor is applicable to the data at hand. It is to be expected that items having a high correlation with the item to be estimated will prove to be the best for developing correction factors.

When the 1947 Iowa State Census was completed, the crop reporters' sample was again matched with the census rolls and control data were taken off for a number of items. Table 7 shows the averages per farm for the crop reporters' sample and the census universe for all data that were thought might be of use. There is a considerable range in the adjustments between items.

Procedure and Costs

A brief explanation of the actual clerical procedure may be helpful to those who may wish to use this approach in mailed surveys.

First, it is necessary to set up master control-data sheets. In this operation, it involved making county lists of the monthly crop-reporters and indicating the townships in which their farms were located. Clerks then took these sheets and found the reporter's name on township census rolls. It is well at this point to consider carefully all possible expansion factors that may be useful and have drawn off all useful pertinent data for tabulation

on the master control sheets, since the major element of cost is in locating the individual name in the census book. From this point any of several variations might be adopted, depending on the degree of accuracy desired and the type of calculation machinery available in the office. If the respondents are a stable and conditioned group, it may be well to compute correction factors for the entire group and use this as a standard for all surveys. This is somewhat risky, for table 4 indicates that the adjustment for sows ranged from 70 to 75 percent in a 6-month period, whereas the factor for the entire sample was 71 percent. In this instance, the subsample fluctuation due to varying response could have been as high as 4 percent.

Actually, the additional work involved in setting up procedure to draw off control data that are comparable with each reported monthly average is simple and inexpensive. In the Iowa office an accordion fold in a listing sheet was made and the sheet was clipped to the county listing of master control information. The schedules for a given month were then tabulated and edited. The item count and comparable totals for current farrowings and census controls were then computed, and the listing sheets and the master control sheets were separated. If the control data were to be used for only one type of survey, they could be listed on one edge of a wide sheet and the monthly reports could be listed in progressive columns to the right. If punch-card equipment is available, the data could be recorded and tabulated mechanically.

A recapitulation of the costs on the Iowa project shows that 248 hours of clerical time were involved in setting up the master control sheets for the group of 1,773 crop reporters. This includes time used in typing names and headings on sheets, locating the respondent on census rolls, drawing off control data, and computing State and district averages for control items. Listing and comparable summarization of the monthly survey results have taken from 8 to 10 hours of clerical time for each monthly compilation and from 3 to 4 hours of a statistician's time to edit the data.

Current Farm Tenure Trends

By Buis T. Inman

Using information collected in the General Enumerative Surveys in January 1947 and March 1948, this discussion brings the trends in farm tenure up to date.

THE extent to which farm operators own or rent the land they farm is of continuing importance to the national economy. This importance arises principally from the influence that the tenure arrangements under which the land is tilled has upon the conservation and use of the land. As the censuses of agriculture provide data on the tenure situation only quinquennially, information that would indicate the situation and trends in regard to tenure since the end of the war has not been available.

To get current information, a few questions on tenure were included in the Nation-wide Enumerative Survey made by the Bureau of Agricultural Economics in January 1947 and April 1948. The resulting data were intended to answer the following questions: (1) What proportion of the farms is operated by each major tenure group? (2) What proportion of the farm land is operated under lease? (3) What is the average size of farms? Data were also collected on a fourth question that has widespread current interest, What is the extent of "father-son farm partnerships"? This article summarizes these data from these two surveys and provides data from the censuses of agriculture for comparisons.[1]

Data for 1947 are based upon a sample of about 14,000 farms; data for 1948 are based upon about 12,000 farms. Trained enumerators visited the farms in the sample areas in 814 counties and obtained the answers to the questions in the schedule during January 1947 and April 1948. The terms used are those commonly used in the censuses of agriculture and the data are comparable with the same items in census reports.[2] The two surveys provided reliable national and regional data. For some items and some States, reliable State data were obtained. No State data are provided by this analysis however.

Resulting information was summarized by the four regions and the nine divisions commonly used in the censuses of agriculture. They are: (1) The Northeast, including the New England and Middle Atlantic States; (2) the North Central, including the East North Central and West North Central States; (3) the South, including the South Atlantic, the East South Central, and the West South Central States; and (4) the West, including the Mountain and Pacific States.

Percentage of Farm Operators by Tenure

The decline in the proportion of farms operated by tenants, first shown by the 1935 Census of Agriculture, still continues in all nine divisions (table 1). The decline was from a high of 42.4 percent in 1930 to 31.7 in 1945 and 27.4 percent in 1948 (table 2). The percentage of tenancy was the lowest in 1948 of any year since 1880—the first year for which tenure data are available. The proportion of farm operators in the South who were sharecroppers declined from 24.1 in 1930 to 12.9 in 1948. This was a more rapid decline than was registered for all tenants.

The proportion of farms operated by part owners has continued upward since 1900, but the rate has been more rapid during the postwar years. Farms operated by part owners represent about one-fourth of the farms in the West North Central and Mountain States—a much larger proportion than in other parts of the country. Part owners are a younger group than tenants or full owners and are expanding their farm business by renting additional acres.

Full owners operated 57.1 percent of the farms in 1948. This is the highest proportion reached since such data were first assembled for 1900. Full owner-operators still continue to be most prevalent in the Northeast and the West. In 1948, 80 percent were in that tenure group in the Northeast, and almost 70 percent in the West.

[1] See also Inman, Buis T. MORE FARMERS OWN LAND, FEWER ARE TENANTS. U. S. Bur. Agr. Econ. Agr. Situation, May 1948, for a discussion of the 1947 data.

[2] See Houseman, Earl E. DESIGN OF SAMPLES FOR SURVEYS, this journal, Vol. 1, No. 1. Also, Brooks, Emerson M. A REPORT ON THE GENERAL ENUMERATIVE SURVEYS–I, this journal, Vol. 1, No. 2.

TABLE 1.—*Percentage of farms by tenure of operator, United States, divisions and selected States, 1945 and 1948*

Region and division	Operators reporting 1948	Tenure					
		Full owners and managers		Part owners		Tenants	
		1945	1948	1945	1948	1945	1948
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
United States	11, 541	57. 0	57. 9	11. 3	14. 7	31. 7	27. 4
Northeast:							
New England	475	90. 0	84. 2	6. 2	13. 3	3. 7	2. 5
Middle Atlantic	1, 139	79. 0	78. 8	10. 3	14. 2	10. 7	7. 0
Total	1, 614	82. 3	80. 4	9. 1	13. 9	8. 6	5. 7
North Central:							
East North Central	1, 575	62. 4	65. 5	14. 1	16. 1	23. 5	18. 4
West North Central	1, 746	45. 8	49. 0	19. 9	24. 1	34. 3	26. 9
Total	3, 321	53. 8	56. 8	17. 1	20. 3	29. 1	22. 9
South:							
South Atlantic	1, 747	56. 5	56. 6	5. 6	8. 8	37. 9	34. 6
East South Central	1, 699	52. 2	51. 9	5. 4	9. 3	42. 4	38. 8
West South Central	1, 470	49. 2	50. 1	9. 5	14. 7	41. 3	35. 2
Total	4, 916	52. 9	53. 0	6. 7	10. 8	40. 4	36. 2
West:							
Moutain	711	57. 6	58. 5	24. 1	23. 3	18. 3	18. 2
Pacific	979	77. 3	77. 9	11. 0	12. 9	11. 7	9. 2
Total	1, 690	68. 8	69. 7	16. 7	17. 3	14. 5	13. 0

TABLE 2.—*Percentage of farms by tenure of operator, United States, 1880–1948* [1]

Year	Farm operators	Percentage by tenure of operator				
		Full owners	Part owners	Managers	All tenants	Croppers (South only)
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1880	4, 008, 907	[3]	[3]	[3]	25. 6	----------
1890	4, 564, 641	[3]	[3]	[3]	28. 4	----------
1900	5, 737, 372	55. 8	7. 9	1. 0	35. 3	----------
1910	6, 361, 502	52. 7	9. 3	. 9	37. 0	----------
1920	6, 448, 343	52. 2	8. 7	1. 1	38. 1	17. 5
1925	6, 371, 640	52. 0	8. 7	. 6	38. 6	19. 9
1930	6, 288, 648	46. 3	10. 4	. 9	42. 4	24. 1
1935	6, 812, 350	47. 1	10. 1	. 7	42. 1	20. 9
1940	6, 096, 799	50. 6	10. 1	. 6	38. 7	18. 0
1945	5, 859, 169	56. 3	11. 3	. 7	31. 7	15. 5
1947 [2]	----------	56. 8	14. 5	. 7	28. 0	13. 3
1948 [2]	----------	57. 1	14. 7	. 8	27. 4	12. 9

[1] Data for census years 1880 to 1945 from Census of Agriculture, Bureau of the Census; data for 1947 and 1948 from Enumerative Surveys, Bureau of Agricultural Economics.

[2] Data from Enumerative Surveys for January 1947 and April 1948. The number of farms for these 2 years estimated to be approximately the same as in 1945.

[3] Data not available.

Approximately half the farms in the West North Central, the East South Central, and West South Central States, are operated by full owners.

Only 0.8 percent of the farms are operated by managers. In no census year since 1920 has the proportion of farms operated by managers been as much as 1 percent.

Land Under Lease

The proportion of farm land under lease, which includes the land in tenant-operated farms, and for 1945 and 1948 the rented portion of part owner- and manager-operated farms, continued to decline in the postwar period, but at a much slower rate than did the proportion of the farms operated by tenants (table 3). This decline was from a high of 44.7 percent in 1935 to 38.1 percent in 1948. The greater rate of decline in the proportion of farms operated by tenants than the rate of decline in the proportion of land under lease reflects the effect of increase in part owner- and small owner-operated farms. In the North Central, West, and Northeast, the proportion of land under lease has continued to decline at about the same rate as before the war. In the South, however, there has been an appreciable increase since the end of the war in the proportion of land under lease. The increase in the South was general throughout the three geographic divisions of that region.

The average size of farm has continued to increase since the end of the war. This increase was from 138 acres in 1910 to 195 acres in 1945 and 204 acres in 1948 (table 4). The average size of full owner- and tenant-operated farms increased in all regions, but tenant farms increased at the faster rate. Part-owner farms increased in size in the Northeast and North Central regions, while the size declined in the South and West. The decline in size of part-owner farms occurred in all three geographic divisions of the South and in the Mountain States. The size of cropper farms has increased from 42 acres in 1945 to 54 acres in 1948.

Causes of the changes in tenure from 1940 to 1945 appear, from an analysis of the data, to be continuing their influences on tenure in similar

TABLE 3.—*Percentage of farm land under lease, United States, regions, and divisions, 1925–48*

Region and division	Operators reporting 1948	Land under lease, by year [1]					
		1948	1945	1940	1935	1930	1925
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
United States	11, 542	38. 1	39. 4	44. 1	44. 7	43. 7	39. 1
Northeast:							
New England	475	8. 4	7. 3	10. 4	10. 7	9. 3	7. 4
Middle Atlantic	1, 139	15. 8	17. 8	20. 0	21. 2	20. 4	21. 4
Total	1, 614	13. 8	14. 7	17. 3	18. 0	17. 2	17. 2
North Central:							
East North Central	1, 575	34. 8	39. 5	40. 9	41. 3	40. 4	37. 3
West North Central	1, 746	45. 0	49. 3	56. 0	53. 7	52. 3	48. 2
Total	3, 321	42. 3	46. 4	51. 6	50. 0	48. 9	44. 8
South:							
South Atlantic	1, 747	31. 1	30. 5	37. 9	41. 3	39. 0	32. 0
East South Central	1, 699	32. 5	31. 6	38. 1	40. 1	39. 2	31. 4
West South Central	1, 470	45. 8	40. 3	45. 1	46. 6	45. 9	41. 7
Total	4, 916	38. 9	36. 1	41. 8	43. 9	42. 7	36. 8
West:							
Mountain	711	35. 9	38. 8	41. 2	44. 5	43. 8	39. 8
Pacific	979	32. 7	36. 1	40. 0	39. 3	38. 8	34. 3
Total	1, 690	34. 9	38. 2	40. 9	43. 1	42. 4	38. 2

[1] Years 1948 and 1945 include portion of manager-operated farms that was rented; previous years do not include this. Data for 1948 from Enumerative Survey; all other data from censuses of agriculture.

TABLE 4.—*Average acreage per farm by tenure, United States, regions, and divisions, 1945 and April 1948*

Region and division	Tenure									
	All farms		Full owners		Part owners		All tenants		Croppers	
	1945	1948	1945	1948	1945	1948	1945	1948	1945	1948
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
United States	195	204	125	133	562	499	135	153	42	-------
Northeast:										
New England	96	100	89	90	168	168	91	(1)	-------	-------
Middle Atlantic	99	115	87	95	161	172	107	144	-------	-------
Total	98	110	87	93	162	170	105	134	-------	-------
North Central:										
East North Central	121	130	92	98	187	206	152	172	-------	-------
West North Central	274	320	172	185	543	675	242	245	-------	-------
Total	201	229	128	137	402	495	207	216	-------	-------
South:										
South Atlantic	93	98	96	101	178	153	63	70	48	54
East South Central	79	87	92	96	130	125	53	63	34	51
West South Central	234	248	178	182	649	442	146	234	48	55
Total	131	140	118	124	369	260	85	115	42	54
West:										
Mountain	1, 151	986	336	428	2, 470	2, 093	480	549	-------	-------
Pacific	254	302	113	107	952	1, 061	284	221	-------	-------
Total	639	581	193	217	1, 897	1, 623	390	405	-------	-------

[1] Insufficient sample for managers and tenants for New England.

ways but in some areas, additional factors are apparently causing some variations from the evident trends.

Mechanization and improved techniques of farming have meant that a decreasing number of farm workers, as well as a decreasing proportion of the Nation's population, are producing our food and fiber. The larger supply of tractors available since the end of the war is particularly significant. Tractors began to affect the size of farms appreciably soon after World War I and are still having an influence in the way of fewer and larger commercial farms. At the same time, expanded industrial development continues to absorb surplus farm labor. Some readjustments since the end of World War II have resulted in increased farm population but indications are that the trend in employment in agriculture is still downward. This indicates that the total number of farms may have declined slightly since 1945, but no estimates of numbers have been made. In areas in which farm population has declined, there has probably been a greater decline in tenants than in owner-operators, since tenants usually have fewer ties to the land. Also, owner-operators rent additional land and so become part owner-operators. The renting of additional acreage by both owners and tenants tends to increase the average size of farms, increase the proportion of part owners, and decrease the proportion of tenancy.

Increase in part-time farming, particularly near large centers of population, is a second factor. As transportation improves, more and more people occupied in nonfarm work are moving to the country to live and to do a little farming as a sort of safeguard. This increases the number of small farms near cities and tends to hold down the average size of farms. As these new farmers are mostly owner-operators, the net effect is to increase the proportion of owner-operators and decrease the proportion of tenancy.

Relatively high farm incomes in the 1940's is a third factor. They have made it easier for farm operators to buy farms. Some owner-operators

TABLE 5.—*Percentage of farms operated as partnerships, and percentage of partnerships by kinship of operators, by tenure, United States and regions, April 1948*

Region and tenure	Operators reporting	Partnerships	Percentage operated as partnerships	Kinship			
				Not related	Father-son [1]	Brother-sister	All other relationships
United States	*Number* 11, 541	*Number* 590	*Percent* 4. 5	*Percent* 8. 5	*Percent* 52. 6	*Percent* 30. 5	*Percent* 8. 4
Northeast	1, 614	75	4. 6	6. 7	50. 6	34. 7	8. 0
North Central	3, 321	196	5. 9	11. 2	58. 7	27. 1	3. 0
South	4, 916	143	2. 9	4. 2	47. 5	32. 9	15. 4
West	1, 690	176	8. 4	10. 5	46. 6	33. 1	9. 8

[1] Also includes father-son-in-law.

have used their larger incomes to buy additional land.

In the South and in parts of the West, *the veterans' program* appears to be a fourth factor. It is large enough to affect the tenure pattern, particularly by increasing the percentage of part-owner farms and by decreasing the average acreage per farm of part owners. A relatively large proportion of the veterans who returned to farming have bought farm land. In those cases in which the local supervisor of the veterans' program considered the farms as too small to be economical, the acreage has been increased. If the increase has been through renting additional land, the owner becomes a part owner-operator. The average acreage farmed by a veteran part owner appears to be smaller than that of other part owners, and, as a consequence, the average size of farm of all part owners has been reduced in these areas. The part owner who is not a veteran frequently owned an adequate-sized unit before he rented other land.

Farm Partnerships

Because of the widespread and growing interest in father-son farm operating agreements and in family arrangements for turning ownership of the farm over to a son before the death of the parents, questions were asked in the 1948 enumerative survey to provide information on the extent of partnerships. The definition of farm partnerships is somewhat ambiguous but the data do indicate the extent of partnership operations as they are thought of by the farmers. For the country, 4.5 percent of the interviewed operators replied that they were operating their farms as a partnership (table 5). Farm partnerships represented the largest proportion of all farms in the West and the smallest proportion in the South. Of the partnerships, 53 percent were between father and son or son-in-law, and 30 percent involved brothers and sisters, or both. The highest proportion of father-son partnerships was in the North Central States. Only 8 percent of the partnerships, in the country as a whole, involved nonrelatives.

Book Reviews

A Critical Review of Research in Land Economics. By Leonard A. Salter, Jr. The University of Minnesota Press, Minneapolis, 1948. 258 pages.

TRAGIC and untimely death in the LaSalle Hotel fire cut short the career of one of the most promising young agricultural economists of Wisconsin and the Nation.

The title of this volume by Professor Salter, published posthumously, is accurate, but the book's most significant and lasting qualities are to be found in the second and third chapters which the author wrote to provide background and criteria for the "critical review."

In most respects, the second chapter is an excellent statement of the Development of Rural Land Economics. It should be read by every land economist. It comes to a focus in the statement that, to date, land economics has been concerned with the "conversion of land from one major use to another general use" and with "problems in the attainment of land tenure objectives". As these have become largely problems of public policy and public control, the account of their development is also useful in interpreting the trend from orthodox to institutional economics.

Scientific Method and Social Science (Chapter III) is by far the most important part of the book. It should be read by all scientists, for it could have been written without any reference to land. It is a fine contribution to the clarification of issues that concern all scientists—natural as well as social. Science is defined as "a continuing process of problem-solving in order to give man a better control over his experience". The author agrees with John Dewey when he says that "The building up of social science . . . is dependent upon putting social planning into effect". The "terminal test of inquiry" is in "experience".

A more widespread understanding of this pragmatic conception of science is sorely needed and the late Professor Salter rendered a real service in writing his chapter on the subject. Much still remains to be done in clarifying the similarities and dissimilarities between natural and social science.

Using the concepts developed in Chapters II and III, the author proceeds through the remaining six chapters to evaluate in considerable detail many of the land economics research publications that had appeared before the time of his analysis. His evaluation is in terms of the extent to which the method used, as revealed by the publications, conformed to his conception of scientific method.

The outcome, as stated in the concluding chapter, is threefold:

(1) "Both personal experience and a review of current land economics literature attest to the fact that research workers are in doubt as to what to do to get research results and make a real contribution to the solution of land economic problems."

(2) "An exploration of the literature of rural social science research reveals that in all branches of the field the same doubts and confusions exist."

(3) "These confusions suggest that something more than refinements in techniques for summarizing collected data may be needed to resolve research confusion and that the inadequate conception of scientific method may be blocking consideration of important issues."

This reviewer finds it possible to agree with Professor Salter on the substance of all of these points, despite the fact that he does not present as evidence the results of his explorations outside the field of land economics. Yet it is a question whether the "doubts and confusions" are as uniform throughout the whole field of rural social science as Professor Salter's conclusions suggest. May not the research workers in land economics be somewhat further advanced in this respect than those in other fields? As a matter of fact, some of the presented evidence indicates that many research workers are still proceeding in blissful

ignorance of any necessity for doubt and uncertainty. In many areas equilibrium economics is still enthroned, and its practitioners announce their conclusions with all the certainty and dogmatism of a revealed religion. Perhaps it was Professor Salter's sense of modesty that caused him to avoid any invidious comparisons between workers in his chosen field and those in other fields.

A still different type of concern if not doubt and confusion—different from the kind the author had in mind and peculiar to those classified by the Civil Service Commission as Land Economists—has arisen during the past two decades as a result of institutional change. In the judgment of this reviewer, both the demise of Land Use Planning under L. C. Gray at the national level, and the rise and fall of County Land Use Planning under H. R. Tolley are attributable in large measure to the increasing tendency at that time for the phrase "land use" to become a synonym for "agricultural." Accepting Professor Salter's own characterization of the field of land economics as one primarily concerned with public policy and public control, what actually happened in the 1930's, was a phenomenal expansion in a field of activities recognized as appropriate objects of public policy and public control.

Thus the growing relative importance of public activities only remotely related to land economics as such, as well as the tendency for soil conservation to be "dominated by physical scientists and engineers" (Dr. Salter), has created for land economists the necessity for orienting their field in the new situation. As only one example, when "production adjustment" in the interest of price stability may or may not involve a shift of land from one major use to another general use, the line of demarcation between "production adjustment" and land economics becomes less distinct—especially when the problems of production adjustment research are referred to workers formerly known as farm-management experts.

That Professor Salter made no use of this aspect of doubt and confusion may have been due to the fact that he considered it irrelevant for his purpose, but it seems to the reviewer that it caused many land economists to look more closely at their "field," which certainly has implications for "method." It seems probable, however, that his failure to make any use of it was due to a faulty conception of the "county land-use planning" episode. In Chapter II he found it unnecessary to interpret that experience. That he did see fit to refer specifically to the "County Land Use Planning Work Outline Number One" reflects a somewhat excessive concern for a technique as compared with the over-all significance of the movement.

Be that as it may, Professor Salter was a scholar of first rank, with a high regard for intellectual and scientific integrity. His "bias" was his low regard for the pretender and the fourflusher.

Bushrod W. Allin

The Economic Mind in American Civilization. Volume 3, 1865–1918. By Joseph Dorfman. Viking Press. New York.

IN A REVIEW of the first two volumes of this series several years ago this reviewer made a summary suggestion, "that every person working with current social problems spend some time, valuable time if necessary, to relive the economic trials of early Americans as described in 'The Economic Mind in American Civilization 1606–1865'." The identical statement cannot be made for the third volume, recently released, which takes us through 1918, although it, too, is a remarkably fine piece of work. The emphasis in the first two volumes is on problems—economic issues. But in the third volume the emphasis changes—the professional economist comes into his own. The story shifts in substance if not in form; it shifts from one of issues and protagonists to one of theory and economists. Thus we do not relive the economic trials of American civilization in that robust but ugly era of industrial growth, combinations, and trusts, 1865-1918, in a reading of volume 3.

As an economist, this reviewer enjoyed this latest volume more than the others. The discovery of Henry C. Adams alone was worth the time spent. Early in that period of industrial growth he had caught its meaning when he

asserted that the central problem of economics "is properly to correlate public and private activity so as to preserve harmony and proportion between the various parts of organic society." The Adams monograph (1887) entitled "Relation of the State to Industrial Action" this reader intends to borrow at the earliest opportunity.

Dorfman gives us cause for new pride in the achievement of Americans in the formulation of economic doctrine. This history causes one to ponder the view that the English have held a monopoly on the development of economic theory; for men like Walker, Adams, Clark, Taussig, Davenport, and Mitchell, were exploring the unknown in as profound a sense as their British cousins. Finally, this volume marshalls considerable evidence to support the view that pure competition theory was probably no more applicable to the nineteenth century than to the twentieth. There is no direct effort to establish this point; still the ideas and concepts set forth would seem to say that pure competition theory should at best have been used only as a teaching device. These are samples of the ideas which grow out of a reading of volume 3, in which the chief concern is with the origins and antecedents of professional economic thought.

But the layman who is trying to understand better and to think through the social and economic problems of today will not find the sense of perspective in this volume that emerges from the first two. Dorfman's discussions of the New England Way in the early colonial period, the Social Philosophies of the Founding Fathers in the struggle for National Survival, Higher Learning 1829–1851 and the Dominant Carolinian Contingent on the eve of the Civil War, illuminate those periods in a way that seems also to illuminate present-day problems. That presentation of continuing economic problems and the failure of the informed or "opinionated" citizenry to achieve satisfactory solutions, make present-day problems seem less terrifying. True, Dorfman presents much of the conceptual picture for 1606 to 1865 through the eyes of early thinkers—for the most part nonprofessional thinkers. But the individuals do not dominate, their ideas and doctrines do not subordinate the problems. Such critical issues as lack of specie and shortage of labor in colonial America, the public debt and the National Bank in the early years of the Republic, dominate the presentation in the first volumes.

All this is not to depreciate the latest volume but to recognize the change in emphasis. This change, which is more a matter of degree than a break with the previous presentation, is probably an inevitable development when the central theme is the reconstruction of "the economic mind" in our civilization. As the discipline of economics developed—very rapidly before and after the turn of the twentieth century—so the theme must follow: first among the professionals who were engaged in the work and second along the paths of their reasoning. And it is not the fault of the text if the development concentrates in the hands of a few and a large part of their reasoning in the period following the Civil War loses contact with economic reality.

The emphasis on marginalism and other tools of analysis in the development of theory had the immediate effect at least of removing economic theory from the arena of economic action. Whether this was good or bad we need not decide here, but one cannot read this new volume which concentrates on the Sharpening of the Pecuniary Logic without wondering what was happening in the world of business and finance and why the theoretical concepts were developing as if in a vacuum. Except on the issue of money and more specifically, silver, the professionals seemed to have decamped, leaving the field of action to those individuals canonized in theory—the entrepreneurs. Economists cloistered in academies of higher learning were refining the theory of pure competition as the operators were engaged in organizing and reorganizing business firms into monopolistic combinations.

Taking the three volumes as a unit, and assuming that a fourth and final volume is under preparation, the series provides an excellent history of economic thought in the United States. Indeed, it is the only history dealing with, or maintaining the continuity of, indigenous economic thought. As such the series lends itself to several uses—source book, text, and general reading. And as the standards of scholarship are high and the story is unfolded in an interesting way, the series should be in heavy demand for all three uses.

Willard W. Cochrane

The Location of Economic Activity. By Edgar M. Hoover. McGraw-Hill Book Company, Inc., New York. 1948. 310 pages, illus. (Economics Handbook Series.)

AS ONE of a series designed to fit a need that is not satisfactorily filled by either the usual textbook or the highly technical treatise, this book packs the essentials of a large and complex subject into small space.

It is a good book. Economists will find little new in the way of facts and theories; it represents an application of some generally accepted economic principles to the problem of location. But the presentation is fresh and the writing is clear. Consequently, by many readers, the complex interrelationships of the numerous factors affecting the location of industries, growth of cities, and differences in the nature and speed of development of regions, will be better understood. Theories and practices of land use, rent, substitutability of the factors of production, wages and labor problems, and other matters that cut across economic life as a whole—as well as such noneconomic considerations as national defense—will have an added meaning.

Attention is directed toward the set of considerations which determines the location of an individual business firm. Procurement, processing, and distribution costs are distinguished. The concept of transfer costs, which embraces all transportation and communication costs and includes procurement and distribution, is introduced. Transfer costs are shown to be a complicated skein. It is indicated why, in a modern economy, early stages of production show a tendency to be material oriented, late stages market oriented, and intermediate stages usually "footloose"—located at some transshipment point or junction. This leads into a discussion of market and supply areas in relation to transfer costs.

Attention next centers on how lack of complete mobility of the factors of production brings about geographical differences in costs of processing, economies of scale, and land-use competition; why there are geographical differences in labor costs and their influence on location. Interrelationships of costs of processing and transfer are shown to explain the economic structure of some typical communities.

The static approach is then abandoned as locational change and adjustment are considered. These are classified as seasonal, cyclical, secular, and structural. A theory of regional development is advanced and the reasons our regions developed differently are examined. Discussions of rural-urban migration and agricultural problem areas will be familiar to agricultural economists.

Next comes an outline of the locational effects of political boundaries. Similarities and dissimilarities between interregional and international trade are indicated, and internal trade barriers are named as an obstacle to the movement of goods and the mobility of factors within this country. This part is probably the briefest in relation to the scope of the subject matter; the student will need additional reading, particularly in the field of international trade.

In the final part *Locational Objective and Public Policy*, the author shows that in the United States, the Government exerts considerable influence on the location of economic activity although most of it is indirect and often unintentional and aimless; for example, the divergence between the sources of public revenues and the places in which they are spent. The objectives of public policy are discussed with respect to location. Flexibility, balance and stability, and military security and power, are considered as alternatives. It is shown that in the real world it would be economically unsound and probably politically unsafe to pursue consistently any one of these alternatives without regard to the others. The emphasis on governmental information services as contributing to locational flexibility reminds agricultural economists of the long-established agricultural outlook work of the Department of Agriculture.

Not all economists will be in full agreement with the treatment given some subjects—as the tendency to minimize somewhat geographical price discrimination, including the basing-point system. Treatment of some important topics is very brief—perhaps necessary in a handbook. Teachers and students, and researchers in general economics, economic geography, agricultural economics, marketing, and transportation, will find the volume useful. Businessmen and public officials, especially legislators and others in policy-making positions, can find much of value in books of this kind.

Bennett S. White, Jr.

Carl Alsberg—Scientist at Large. Edited by Joseph S. Davis. Stanford University Press, Stanford, California, 1948. 182 pages.

THESE biographical essays describe the evolution of an agricultural economist. Alsberg's career never broke away from his past. Each stage in his life's journey made its contribution and moved him toward the next stage. His intellectual frontier moved from the natural to the social sciences; from pharmacology to biochemistry, on to the specialized chemistry of foods and then to the economic and social problems of the food supply, until he found himself accepted as an agricultural economist, his spurs having been earned by 40 years of contributory related experience. As he recognized no barriers in the flow of knowledge, his interests naturally extended into the field of international scientific cooperation. Science to him was a tool for universal application. As Kroeber remarks, "he forged into leadership through sheer weight of ability."

Each of these five essays was prepared by the person best fitted to throw light on one aspect of Alsberg's career and each makes its distinct contribution to the portrait of the growing, broadening man and yet they are all of one piece. Carl Alsberg looked the same to his many friends. Each saw a unique segment of the whole life but all of the segments dovetailed perfectly into a total mosaic, or complete man.

The contributors are Alfred L. Kroeber, anthropologist and life-long friend, Donald Van Slyke, brother chemist, Fred B. Linton, his one-time administrative assistant, Robert D. Calkins, economist colleague who witnessed the actual shift into the social science domain, and John B. Condliffe, co-worker in international relations pioneering. In a foreword Joseph S. Davis, colleague Director in the Food Research Institute, and architect of this volume, tells how the book was designed to share an "intimate knowledge of this extraordinary man." Each writes with the affection and respect that fellow scholars hold for a master of his field.

The spirit of Alsberg is partially captured by incidents described in these five vignettes but none presents the man and his methods of work so well as two short essays by Alsberg himself, which are happily included to round out the portrait. The first, "What the Social Scientist Can Learn from the Natural Scientist," was given before a scientific group in 1931. The second, a commencement address at Reed College in 1938, has no title; it could be called "My Testament of Faith" for in it Alsberg attempted to impart to the coming generation the lessons from his life's rich experience. It breathes the spirit of tolerance—the spirit of the true scientist. It is Alsberg almost in the flesh, and it reflects his absorbing interest in young people as the hope of the future.

Rather than attempt to re-tell the story of this life and to assess its significant contributions, so well done in this brief volume, the reviewer refers to Alsberg's point of view as a research administrator and scientist as this may be of peculiar interest to agricultural economists.

As a research administrator Alsberg early learned that "You cannot buy research." He advised, "Never assign a man to do a research job unless he has a twinkle in his eye and wants to do it more than anything else." Moreover, he was an advocate of inductive research in both the natural and the social sciences. He expressed his position in these words, "I am convinced that in any science the accumulation of facts is of first importance . . . when the time is right, because of an adequate accumulation of facts, the general unifying principle is sure to occur at about the same time to a number of persons."

This led him to hold with respect to the social sciences that there was "too much integration, too little differentiation; too much spinning of hypothetical theories without regard to their verifiability; too little spade work in digging out facts. If in the social sciences, and especially in economics, more attention were devoted to the recording of what seem important facts and to the analysis of their significance, I am confident we should not need to worry about theory." This line of reasoning led Alsberg to suggest that there be "less writing of books and more publication of brief communications."

This is a good note on which to close this brief review. The authors of this little volume prove Alsberg's point that "with an adequate accumulation of facts, theory very soon becomes obvious to any first class mind." In this case, the facts here portrayed well present the theory of the man.

Joseph G. Knapp

Sugar and Its Wartime Controls, 1941–47. By Earl B. Wilson. v. I–IV. Statistical Press, Inc., New York, 1948.

The Sugar Industry and the Federal Government. A Thirty Year Record (1917–47). By Joshua Bernhardt. Sugar Statistics Service, Washington, D. C., 1948. 344 pages.

International Control of Sugar, 1918–41. By B. C. Swerling. (Commodity Policy Studies 7) Stanford University Press, Stanford, Calif., 1949. 69 pages.

DEVELOPMENT of controls over each segment of the sugar industry during the war is discussed chronologically in half of the first volume of Wilson's work, and each wartime problem of the industry is analyzed. The remainder of that volume and the other three are devoted to documentary exhibits: purchase contracts, governmental orders, congressional hearings, sugar legislation, and basic statistics.

The text is concise, comprehensive, and incisive. Wilson judges the value of most of the programs from the viewpoint of their objectives, often presents alternative programs which he believes would have been better, and outlines in detail the controversies involved in the development of many of the programs.

Some of his more important conclusions follow. The problem in regard to sugar in the early years of the war was essentially one of shipping; in the later years it was one of production. Prices were held at the lowest level too long, for the value of the savings to consumers at high levels of prosperity was questionable when higher prices would have been more encouraging to producers than the uncertain and delayed CCC programs. Great increases in production in Cuba returned a substantial profit, but the bulk of its crop was sold to us at a reasonable price. Many of the programs to encourage the production of domestic beets were of the category of too-little and too-late; domestic beet processors were worse off than any other branch in the industry in the 1943–45 period because of apparent lack of interest in their problems at official policy levels. Sugar rationing, despite its shortcomings, was the most successful of the food-rationing programs and, unlike rationing of other foods, was not removed until adequate supplies were available. Equitable distribution of sugar throughout the country was one of the outstanding achievements of the OPA—made possible through the wholehearted cooperation of the entire sugar industry which was subject to more rigid controls than any other industry.

This evaluation of the sugar controls is a frank and readable statement by one who worked tirelessly in their development and administration, trying to avoid the pitfalls that developed in World War I. When evaluating Wilson's criticism of the programs, a reader must not lose sight of the fact that these controls were but one aspect of the over-all economic controls that operated during the war; that these programs competed with others, and, at times, some ran counter to the social objectives of economic policy. But Wilson's work is an excellent presentation of one aspect of wartime economic controls, and an important contribution to the literature on governmental economic policy.

Dr. Bernhardt's book is divided into four parts: (1) Governmental Control, World War I; (2) The High Tariff Period (1920–34); (3) The Sugar Programs of the Roosevelt Administration; and (4) Control of Sugar During World War II. The material in the first part is a digest of an earlier book and a reprint of an article that appeared in an economic journal. Reprints of reports of Federal agencies and official testimony presented to congressional committees make up most of the rest of the material.

One of the chief values of this book is that it gives the reader historical perspective in appraising the wartime and present sugar controls. The continuity of Federal controls under earlier legislation—the Jones Costigan Act of 1934 and the Sugar Act of 1937—facilitated the mobilization of the industry from prewar to full war status. This compilation of official documents is of great value, but it is difficult reading. Short summaries of the periods of control would have added much to the usefulness of the volume.

This "elder statesman" of Government controls in the sugar industry tells the reviewer he considers this book the first of several. In the others he will offer critical analyses of the controls.

In his pamphlet, Swerling analyzes the economic aspects of world sugar production, reviews Cuba's unilateral attempts at international control in

the 1919–30 period, reviews the International Sugar Agreements of 1931 and 1937, and analyzes the common factors in the international sugar agreements.

Swerling concludes that the International Agreement of 1931 was faulty in concept since it failed to include importer countries, and in action since the quotas adopted were too high and inflexible. These errors were largely corrected in the 1937 agreement, but tardy ratification by member countries and the outbreak of the war prevented desired results. He maintains that international sugar agreements have been mostly free of the faults common to other commodity agreements. Consumer interests have not been ignored, and quotas have served less to freeze obsolete trade channels than to perpetuate international intercourse. He believes these agreements to have been necessary to fortify the most efficient producing areas against excesses of nationalistic policy.

Present conditions of an impending surplus of sugar call for careful investigation by an international study group, Swerling maintains, to evolve a program to modify the nationalistic policies that have plagued the industry. Yet sadly but realistically he concludes "from past performances one may be justifiably pessimistic about the prospects for prompt corrective or preventive action. Agreements have typically been arrived at only after the sugar problem has reached crisis proportions. Once postwar sugar surpluses become a reality, a new international agreement would be a minor encumbrance upon a world sugar industry to which economic liberalism has long since become a stranger."

Maxwell I. Klayman

Selected Recent Research Publications in Agricultural Economics Issued by the Bureau of Agricultural Economics and Cooperatively by the State Colleges [1]

Alexander, Frank D., and Nelson, Lowry. RURAL SOCIAL ORGANIZATION IN GOODHUE COUNTY, MINNESOTA. Minn. Agr. Expt. Sta. Bul. 401, 85 pp., illus. February 1949. [Printed]

One of a series of studies carried out in counties selected to represent the major type-of-farming areas in the United States. Goodhue County is one of the five dairy counties selected. The authors conclude that community life is increasingly integrated around village-centers; that formal organizations are increasing because of need for group action; that ethnic groupings have survived in churches but are relatively unimportant in secular organizations; that a broad participation base characterizes the county's social organizations; and that the county has moved far along the road toward formalized and secondary group life.

Mesick, David O., and Brodell, Albert P. FARM MACHINERY. 5 pp. Bur. Agr. Econ. Mar. 15, 1949.

According to a sample interview survey made by the Bureau of Agricultural Economics in April 1948, farm inventories of most types of farm machinery were at an all-time high about May 1, 1948. An exception—grain binders are replacing combines. Mechanization is greatest in the Corn Belt and Iowa leads the Nation in this respect.

Senf, Catherine. THE FARM ACCIDENT SITUATION IN 1948. 8 pp., illus. National Safety Council, Chicago, Ill. (Department of Agriculture cooperating) [1949]. [Printed].

Estimates contained in this article are based on three sample surveys conducted by the Bureau of Agricultural Economics. 35,892 interviews were made with farmers and a total of 1,927 accidents were reported.

Slusher, M. W., and Mullins, Troy. MECHANIZATION OF THE RICE HARVEST. Ark. Agr. Expt. Sta. Rept. Ser. 11, 30 pp., illus. August 1948.

A progress report dealing with methods of harvesting rice which is a part of a larger study of mechanization of rice and its implications in Arkansas. Combine and binder methods are compared as to labor and power used, principal equipment required, average use, costs of owning and operating, and total harvesting costs. (BAE cooperating; RMA report)

United States Bureau of Agricultural Economics. MEN'S PREFERENCES AMONG SELECTED CLOTHING ITEMS. PRELIMINARY SUMMARY REPORT. 16 pp. March 1949.

A summary of major findings as to the relative preference expressed by male consumers for the various competing fibers—cotton, wool, rayon, nylon, and their mixtures—in certain selected articles of clothing. Also shown are the beliefs men say they have regarding the advantages and disadvantages of each of the competing fibers in these garments. (RMA report)

United States Bureau of Agricultural Economics. POTATO PREFERENCES AMONG RESTAURANT AND HOTEL BUYERS. U. S. Dept. Agr. Misc. Pub. 682, 92 pp., illus. April 1949.

[1] Printed reports are indicated as such. All others are processed. State publications may be obtained from the issuing agencies of the respective States.

Shows attitudes of commercial users of potatoes toward present marketing practices and kinds of potatoes in two cities—New Orleans, a low-consumption area; and Cincinnati, a high-consumption area. The information obtained may provide a basis for estimating the prices and returns to producers which might be expected to follow certain changes in marketing practices, or to follow a definitely increased efficiency in marketing. (RMA report)

United States Bureau of Agricultural Economics. POTATOES IN HOTELS AND RESTAURANTS. LIKES AND DISLIKES AMONG THOSE WHO BUY FOR PUBLIC EATING PLACES. HIGHLIGHTS FROM SURVEY IN TWO CITIES. U. S. Dept. Agr. AIS–81, 8 pp., illus. 1949.

Statistical Compilations

Horton, D. C., Lingard, H. T., Engberg, R. C., and Moore, A. S. FARM MORTGAGE LOANS MADE OR RECORDED BY PRINCIPAL LENDERS, DATA FOR UNITED STATES AND GEOGRAPHIC DIVISIONS, 1910–48. 14 pp. Bur. Agr. Econ. April 1949.

Kimball, E. Smith, Smith, Paul W., and Moore, Robert F. FARM PRODUCTION, DISPOSITION, CASH RECEIPTS AND GROSS INCOME: CHICKENS AND EGGS, 1947–1948, CHICKENS ON FARMS, JANUARY 1, 1948–1949, BY STATES. 16 pp. Bur. Agr. Econ. April 1949.

Kimball, E. Smith, Smith, Paul W., and Moore, Robert F. FARM PRODUCTION, DISPOSITION, CASH RECEIPTS AND GROSS INCOME: TURKEYS 1947–1948; TURKEYS ON FARMS JANUARY 1, 1948–1949, BY STATES. Bur. Agr. Econ. 8 pp. March 1949.

United States Bureau of Agricultural Economics. FARM PRODUCTION, FARM DISPOSITION, AND VALUE OF FIELD AND SEED CROPS, 1947 AND 1948. 41 pp. May 1949.

United States Bureau of Agricultural Economics. FARM PRODUCTION, FARM DISPOSITION, AND VALUE OF PRINCIPAL CROPS, 1947–48, BY STATES. 41 pp. Washington, D. C. 1949.

United States Bureau of Agricultural Economics. MEAT ANIMALS—FARM PRODUCTION AND INCOME, 1947–48. 8 pp. Washington, D. C. 1949.

United States Bureau of Agricultural Economics. STOCKS OF BARLEY AND RYE ON FARMS, CROP YEARS 1939–1948. 10 pp. Washington, D. C. 1949.

Wilson, John L., and Taylor, Frank M. under the direction of B. H. Bennett. FARM PRODUCTION, DISPOSITION AND INCOME FROM MILK, 1947–48. 12 pp. Bur. Agr. Econ. April 1949.

Wilson, John L., and Taylor, Frank M., under the direction of B. H. Bennett. INTERSTATE MOVEMENT OF DAIRY CATTLE, 11 NORTHEASTERN STATES, 1948. 9 pp. Bur. Agr. Econ. April 1949.

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